

**Research on Controlling Embodied Carbon in China's Inter-provincial Trade - A Case Study of Guangdong Province**

**July 2020**

**Chen YU**

**Research on Controlling Embodied Carbon in China's Inter-provincial Trade - A Case Study of Guangdong Province**

A Dissertation Submitted to  
the Graduate School of Life and Environmental Sciences,  
the University of Tsukuba  
in Partial Fulfillment of the Requirements  
for the Degree of Doctor of Philosophy in Environmental Studies  
(Doctoral Program in Sustainable Environmental Studies)

**Chen YU**

## **Abstract**

Embodied carbon in foreign trade has become a hot issue in the research of the relationship between trade and environment in recent years. Effectively defining the embodied carbon emission responsibilities of various provinces can strengthen the technological innovation in the region and improve the energy utilization efficiency. Guangdong province has ranked first in China since 1986 in terms of its total foreign trade volume and export volume. By 2019, the total retail sales of social consumer goods in Guangdong province has reached 426.446 billion CNY, up 8.0% year on year, and reached the highest growth rate in recent years. The total amount of carbon emissions in Guangdong accounts for about 11% of the total national emissions. Therefore, studying the embodied carbon in inter-provincial trade and putting forward reasonable policy suggestions will help Guangdong to achieve its carbon emission reduction targets, and also help the Chinese government to realize its carbon emission reduction commitments to the world. At the same time, it is of great significance to the determination of carbon emission reduction responsibility and the settlement of trade friction.

Embodied carbon emission model in this research is constructed to analyze the Embodied carbon emission characteristic and transfer footprint in China under the inter-provincial perspective. China's Multi-regional Input-Output Table in 2010(the latest Multi-regional Input-Output Table) is the research basis. Embodied carbon emission model adds factors such as total carbon emissions and carbon emission intensity, makes modifications and further refinements to carbon emissions, and calculates the relationship between the transfer of embodied carbon in inter-provincial trade in China's 12 sectors of 30 provinces. The social cost of embodied carbon model is constructed to analyze the key provinces and sectors that need to bear the responsibility of reducing emissions and paying social costs in inter-provincial trade. The emission reduction prediction model is constructed to analyze the specific total amount of embodied carbon emission reduction after adopting advanced technologies. This research calculates the emission reduction rate of new technologies and substitutes the obtained results into the embodied carbon model.

After the construction of embodied carbon emission model, social cost of carbon model and emission reduction model, this research finds that, the direction of embodied carbon

transfer in China's inter-provincial trade is generally from inland areas rich in resources and developed in heavy industry to the areas that high-tech industries are concentrated and tertiary industries are developed. Guangdong Province's total import volume is 73.69 million tons, with a net value of -72.95 million tons. In order to guide the flow of funds to key sectors of emission reduction, this research selects the Carbon capture and storage advanced technology, an efficient and reliable method of carbon emission reduction. After the reduction prediction, this research finds that, CCS can bring 30%-50% of the embodied carbon direct emission reduction rate for key industries in key regions. In addition, it can bring 5%-17% of the embodied carbon indirect emission reduction rate for other industries.

In conclusions, the direction of embodied carbon transfer in China's inter-provincial trade is generally from inland areas rich in resources and developed in heavy industry to the areas that high-tech industries are concentrated and tertiary industries are developed. The social cost of embodied carbon structure in China is that provinces need to pay the cost of emission reduction are mostly located in areas with developed resources, backward economic development and concentrated heavy industry. Economically backward regions need to bear more responsibility for reducing embodied carbon emission. Carbon capture and storage advanced technology, as an efficient and reliable method of carbon emission reduction, China should strengthen technological innovation, improve the level of advanced technology, and actively promote the harmonious and sustainable development of inter-provincial trade and environment.

This research analyzes the embodied carbon transfer and social cost in inter-provincial trade and evaluates the relationship between Guangdong and other provinces' embodied carbon emission and their emission reduction responsibilities. This can provide reference for national and provincial government departments to adjust trade structure and development direction. It is necessary to give full play to the role of inter-provincial trade in energy conservation and emission reduction.

**Keyword:** Embodied carbon emission; Inter-provincial trade; Social cost of carbon; Advanced technology; Emission reduction prediction