Carbon Emission Policies Impact in Logistics Supply Chain Networks

This thesis is submitted in accordance with the requirements of the University of Liverpool for the degree of Doctor in Philosophy

by

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ABSTRACT

Environmental issue is becoming a serious global concern. Human activities associate with industrial activities and households produce a great amount of greenhouse gases, particularly carbon dioxide, and gives significant impact on the environment. The legislation on carbon emissions has become an important agenda in order to control the amount of carbon emissions that might affect the world for future generations. In conjunction to this issue, therefore, the research was conducted to investigate the impact of the carbon emission policies on reverse and forward logistics strategies and operations and propose optimisation models for the paper recycling and fresh produce industry with cases in the UK. The optimal network design approach for both cases under carbon emission control is formulated. The research concluded that exporting the waste paper to Asia is a better option when pollution from the recycling is not charged. However, when considering the carbon emission in both the UK and the Asian country, the best strategy would depend on the amount of recycling and the differences between the costs of the recycling locally and overseas. For fresh produce case, with no carbon policies, road is a better transportation option. However, if the industry has to pay for carbon emission, consideration of multimodal transportation has to be made in order to remain optimal. The analysis of business strategies and configuration of reverse and forward logistics networks are carried out with quantitative optimisation modelling. The analysis for paper recycling and the fresh produce industry consider contributions to the environment and costs in relation to carbon emission. Mixed integer linear programming models were developed for both cases to obtain the optimal choice in strategic and operational decision making. Transportation industry is a main contributor of greenhouse gases that give direct impact to the environment. Multimodal transportation planning is important because it can help to reduce impact on the environment, by using a combination of at least two modes of transportation in a single transport chain, without a change of container for the goods, with most of the route travelled by road, rail, inland waterway or ocean-going vessel and with the shortest possible initial and final journeys by road. Multimodal transportation planning is proposed in the fresh produce industry with another variable which is time. The analytical result derived from sensitivity analysis is discussed to draw academic and practical findings for carbon control policy making and logistics network configuration. The research outcome has a good generic contribution to eco-logistics management of other recycling materials and to generic logistics network configuration issues. The research is also significantly contributed to government policy making in carbon emission control.
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CHAPTER ONE

INTRODUCTION

1.1 RESEARCH BACKGROUND

The world population reached seven billion people by the end of 2011. With the increasing number of human beings, humankind has had a considerable impact on the environment. Environmental issues constitute the most serious problem in every part of the world. Global warming, which is mainly caused by the emissions of greenhouse gases (GHGs), is said to contribute significantly to these environmental problems. Although there are many types of GHGs that have an impact on the environment, such as water vapour, carbon dioxide, methane, nitrous oxide, ozone and chlorofluorocarbon (CFC), this study focuses on carbon dioxide emissions, which constitutes the largest portion of gas emissions.

In order to facilitate the control of carbon emission, environmental legislation has been extended. Since the Kyoto Protocol in 1997, most countries around the world have tried to reduce their carbon emission. Developed countries, which fall under Annex I of the Kyoto Protocol have to reduce their overall emissions by at least 5% below the 1990 level in the commitment period 2008-2012 (UNFCCC, 1998). In the United Kingdom (UK), according to the National Action Plan Phase II, the goal is to reduce carbon emission by 12.5% below base year over the same commitment period (Defra, 2007).

Humankind’s actions produce waste that is generated from industrial and household activities. Such waste generates a significant impact on the environment. The logistics and recycling networks to reprocess waste products to reduce pollution and recover value have
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REFERENCES


