A branch-and-price algorithm for production routing problems with carbon cap-and-trade

Yuzhuo Qiu, Jun Qiao, Panos M. Pardalos

www.elsevier.com/locate/omega

PII: S0305-0483(16)30292-4
DOI: http://dx.doi.org/10.1016/j.omega.2016.06.001
Reference: OME1679

To appear in: *Omega*

Received date: 8 May 2015
Revised date: 10 February 2016
Accepted date: 6 June 2016

Cite this article as: Yuzhuo Qiu, Jun Qiao and Panos M. Pardalos, A branch-and-price algorithm for production routing problems with carbon cap-and-trade *Omega,* http://dx.doi.org/10.1016/j.omega.2016.06.001

A branch-and-price algorithm for production routing problems with carbon cap-and-trade

Yuzhuo Qiu[a,b], Jun Qiao[a], Panos M. Pardalos[b,*]

[a] *Jiangsu Key Laboratory of Modern Logistics, School of Marketing and Logistics Management, Nanjing University of Finance and Economics, Nanjing 210023, China.*
[b] *Department of Industrial and Systems Engineering, Faculty of Engineering, University of Florida, Gainesville 32611, United States*

Abstract

This study presents a model for a pollution production-routing problem under carbon cap-and-trade. The aim is to incorporate carbon emissions into production inventory and routing decisions. The model is characterized by an additional flow-related cost structure, which generalizes models for pollution-routing problems and production inventory and routing problems. Correspondingly, we develop a branch-and-price heuristic by incorporating a column-generation formulation based on the Dantzig–Wolfe decomposition. In addition, we design an ad hoc label-setting algorithm to deal with time-slice networks in pricing subproblems. Computational results allow us to provide managerial insights concerning reduction of carbon emissions in supply chains. We prove that the model has the potential to reduce emission levels of carbon dioxide and operational costs.

Keywords: Routing; Production planning; Branch and bound; Dynamic programming; Environmental studies

1. Introduction

Emissions of carbon dioxide (CO_2) and other greenhouse gases (GHGs) have posed major threats to human health and environment (Cinar et al., 2015; Zheng et al., 2012). Thus, such countries as the US and China have developed rules and policies to control carbon emissions. In addition, company managers have started to consider regulations on GHG emissions from production and freight transport when making operational decisions. Thus, a key problem is how these decisions and corresponding carbon emissions along supply chains might react to those policies. Solutions to the key problem determine reasonable ranges for parameters of carbon policies, such as carbon price and carbon cap. Therefore,

*Corresponding author, phone:(352)392-9011 ext 2017
Email addresses: jadeqyz@gmail.com (Yuzhuo Qiu), qiaojun_nj@163.com (Jun Qiao), pardalos@ufl.edu (Panos M. Pardalos)