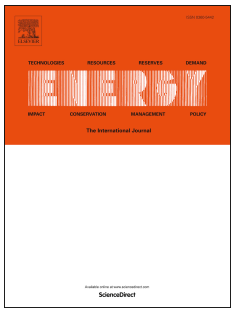
Accepted Manuscript



Network design and technology management for waste to energy production: An integrated optimization framework under the principles of circular economy

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PII: S0360-5442(17)31907-2

DOI: 10.1016/j.energy.2017.11.058

Reference: EGY 11846

To appear in: *Energy*

Received Date: 3 March 2017

Revised Date: 22 October 2017

Accepted Date: 9 November 2017

Please cite this article as: Yılmaz Balaman Ş, Wright DG, Scott J, Matopoulos A, Network design and technology management for waste to energy production: An integrated optimization framework under the principles of circular economy, *Energy* (2017), doi: 10.1016/j.energy.2017.11.058.

Network design and technology management for waste to energy production: an integrated optimization framework under the principles of circular economy

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Abstract

The design of waste to bioenergy supply chains (W-BESC) is critically important for meeting the circular economy (CE) goals, whilst also ensuring environmental sustainability in the planning and operation of energy systems. This study develops a novel optimization methodology to aid sustainable design and planning of W-BESC that comprise multiple technologies as well as multiple product and feedstock types. The methodology identifies the optimum supply chain configuration and plans the logistics operations in a given region to meet the energy demand of specified nodes. A scenario based fuzzy multi objective modelling approach is proposed and utilized to capture the economic and environmental sustainability aspects in the same framework. We test the proposed model using the entire West Midlands (WM) region from the United Kingdom (UK) as a case study. In this scope, a comprehensive regional supply chain is designed to meet the energy and biofertilizer demand of specific nodes considering available waste and crop type biomass in the region. Further analysis is conducted to reveal the impacts of main economic and technological parameters on the supply chain performance indicators.

Keywords: Waste to energy supply chains; Network design; Technology management; Mathematical modelling; Fuzzy multi objective decision making

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1. Introduction

CE fundamentally lies on the idea of transforming products, production systems and supply chains in order to establish workable relationships between ecological systems and economic growth, pushing also the frontiers of environmental sustainability. The focus is on the creation of self-sustaining production systems in which materials are used over and over again (Genovese et al., 2015). Incorporating these CE principles into the supply chain planning and management strategies for energy systems, is important for minimizing material flows and for reducing unintended negative consequences of production processes (Srivastava, 2007).