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Time-dependent material flow analysis of iron and steel in the UK Part 1: Production and consumption trends 1970–2000

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Abstract

This paper presents a detailed account of the supply chain for iron and steel in the UK, using material flow analysis. Due to the lack of a universally agreed methodology of material flow analysis, we include an explanation of the accounting methodology employed in the study. Data for the supply chain has been collected reaching back three decades, enabling analysis of trends in production and consumption of iron and steel over the years. This first part of a series of two papers quantifies the iron and steel flows through the UK economy including the annual amount of iron and steel embodied in all final goods that enter the use phase in the UK. The second part explores the more elusive flows of scrap generation and recycling. In this first paper we show that the UK no longer has the capacity to recycle the scrap it collects and is increasingly relying on foreign economies to do so. We also observe that trade in iron and steel products and ferrous metal containing final goods has increased dramatically over the years, but remained relatively balanced. Today, one-half of UK's iron and steel production is exported, whereas one-half of the iron and steel entering the UK use phase comes from

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imported final goods. The efficiency with which the UK iron and steel industry transforms iron ore and scrap into iron and steel products has increased substantially. However, there is no significant downward trend in the absolute level of iron and steel use in the UK. Between 1970 and 1981 the annual amount of steel put to use dropped from 16.4 to 10.7 million metric tonnes but climbed back up to 15 million metric tonnes twice since then.

Keywords: Iron and steel; Time-dependant material flow analysis; UK; Production; Consumption; Scrap; Industrial ecology; Supply chain

1. Introduction

In this series of two papers, we use time-dependent material flow analysis (MFA) to examine the UK iron and steel cycle between 1970 and 2000. According to Bringezu and Moriguchi (2002), MFA can be defined as the quantitative accounting of material inputs and outputs of processes in a systems or chain perspective. It is usually regarded as an integral part of industrial ecology and has become a fast-growing field of research with increasing policy relevance (Graedel and Allenby, 2003). Material flows and transformations are the backbone of economic production and consumption systems and also the root cause of the environmental concerns they create (Jackson, 1996). MFA helps to assess the impact that economic systems have on the natural environment and is essential to quantify production and use of specific materials or overall dematerialisation of economies (Bringezu and Moriguchi, 2002). According to Graedel (2002), MFA is usually employed to answer one or several of the following questions:

- How much material enters the system?
- How is the material transformed?
- How much material is added to the stock in use?
- How much material is recycled?
- How much material escapes from the system to the environment?
- How much material ends up in landfill?
- What trends exist in these flows and stocks?

Part 1 of this paper series answers the first three questions for iron and steel in the UK economy and discusses the trends observed over the last three decades. Answers to these questions enable us to discuss the materials intensity of economic systems. Part 2 (Davis et al., 2007) is dedicated to the next three questions, which all concern the level of closure of anthropogenic material cycles. Deriving robust answers to this central issue in industrial ecology is far from trivial.

The idea that mature industrialised economies naturally dematerialise, i.e. need less and less material resources per unit of GDP, has been put forward in a number of papers; see, e.g. Malenbaum (1978), Humphreys and Briggs (1983), Tilton (1985) and Jänicke et al. (1989). This hypothesis has been challenged by several arguments. Labys and Waddel (1989) argue that studies that take only a few materials into account ignore the observation that over time new materials can substitute traditional ones, which leads to a decreasing