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Application of Energy-Carbon Flow Charts in High-Tech Industrial Park

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Abstract

The energy structure and carbon emissions become more and more important for the sustain-able development of a regional construction. The purpose of this paper is to apply the energy-carbon flow charts to analyze the energy use and carbon emissions in a high-tech industrial park. The characteristics of the charts applied in a park are very different from that of a coun-try, a province or a product. The authors propose a preliminary drawing frame to guide the effective application of the chart for a park. The frame presents the steps and focus of the drafting work. A case application is also introduced to illustrate the applicability of the frame to practical problems, the results are very helpful to optimize the energy structure and reduce the carbon emissions.

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Keywords: Energy-carbon flow charts, High-tech industrial park, Energy optimization, Carbon emissions reduction

1. INTRODUCTION

The energy-carbon flow charts are derived from the energy flow chart. The researchers add the carbon emissions data to it in order to visualize both the energy and carbon flow. The charts are used to analyze the energy utilization efficiency, the carbon emissions structure and the balance between energy supply and demand. They are effective tools to make energy saving and carbon emissions reduction policies, and to optimize energy management and structure.

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1.1. Energy Flow Chart

The development of the Energy Flow Chart (EFC) began in 1898, when Sankey used the EFC to analyze energy efficiency of a steam engine. Then the EFC is widely used to show an over-all picture of the energy or other material supply, transportation and end use data[1]. The Law-rence Livermore National Laboratory(LLNL) of the U.S. published national EFC first in 1972, and it has been updated and published regularly[2]. With the in-depth understanding and application of the EFC, many countries draw national EFCs based on the energy balance sheet (Fig.1~2), including Chinese researchers. According to the EFC structure of the Energy Information Administration of America, LI Zheng et al. drafted the China EFC of 2003 and 2004 by appropriately adjusting the classification of China energy balance[3]. Referring to the EFC of the UK BERR(Department for Business, Enterprise and Regulatory Reform), XIE Shichen etc. draw the China EFC of 2006 [1]. HU Xiulian et al. drafted the China EFC of 1980, 1995, and 2012(Fig.2(b)), and also China Coal System Chart of 2012[4].

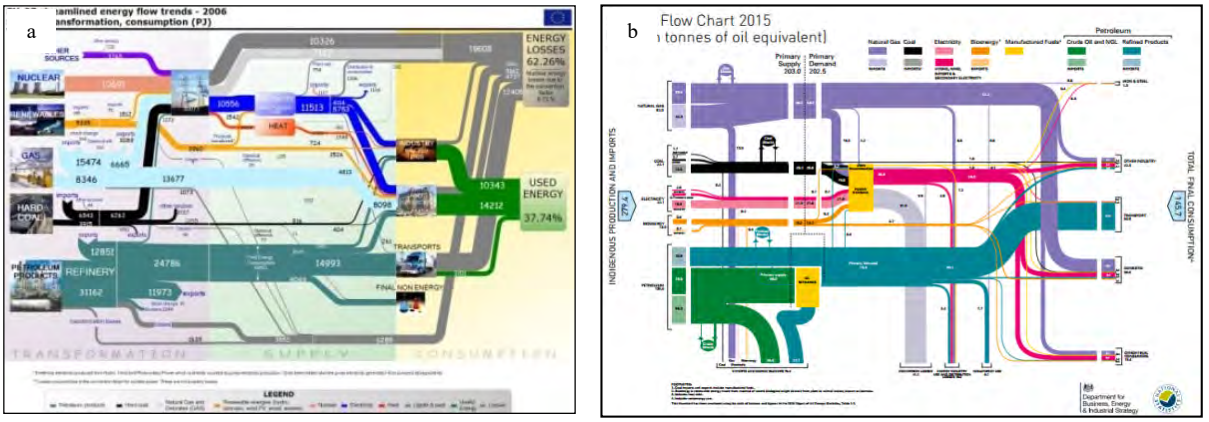

Fig. 1. (a) Europe energy flow chart of 2006; (b) U.K energy flow chart of 2015

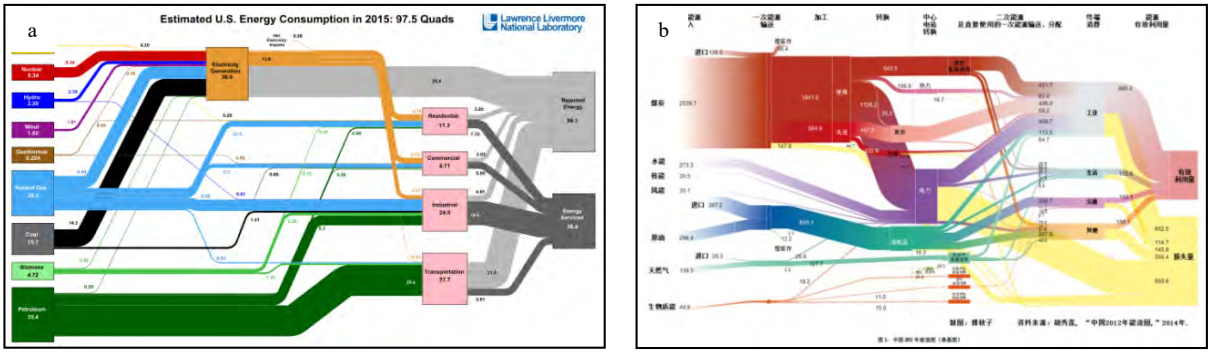

Fig. 2. (a) U.S. energy flow chart of 2015; (b) China energy flow chart of 2012

The EFC is also applied widely in analyzing energy problems for a region or a product. YANG Lei et al. drafted the EFC of Guangdong Province of 2008 to analyze the influent factors of the energy supply security[5]. ZHANG Ming et al. drafted the EFC of Shandong Province of 2008 to analyze energy situation and utilization efficiency[6]. SONG Yuan et al. analyzed the energy flow of 2009 in order to study the constraints for developing renewable energy in Heilongjiang Province and propose reasonable solutions[7]. SUN Ning used the EFC to analyze the influence of the processes on the energy consumption of air conditioning system[8].