

Consumer Lifestyle Approach to Quantify CO₂ Emissions Caused by Domestic Washing Clothes

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Abstract

Household CO₂ emissions are gaining more attention from researchers in recent years. Domestic washing is an important household routine and one of the main sources of household CO₂ emissions. In this paper, Consumer Lifestyle Approach (CLA) was used to quantify CO₂ emissions from domestic washing. An investigation of 493 families, from 16 cities out of 8 provinces in China, was held to study the five main household characteristics including the demographic composition, living condition, family income and expenditure, education level and most importantly, laundry habit. The relationship between domestic washing characteristics and CO₂ emissions is concluded from multi-variable linear return analysis. The results show that family's washing frequency as well as washing machine's efficiency and capacity are major factors which affect CO₂ emissions. Other factors such as per capita living space, family working population and education level also have an influence to a certain extent.

Keywords: Domestic Washing; CO₂ Emissions; CLA; Multi-variable Linear Return Analysis

1 Introduction

Severer than ever, humankind is facing a gradual rise in earth's temperature, known as global warming. It is generally believed that global warming is caused by high level of Greenhouse Gases (GHGs), mainly caused by human activities [1]. GHGs consist of carbon dioxide (CO₂), methane (CH₄), etc, among which CO₂ has the largest proportion and highest influence on the environment. Analysis of CO₂ emissions from energy consumption has recently gained more attention from researchers and scholars [2]. At the same time, the influencing factors towards energy use and CO₂ emissions are under extensive research and discussions around the world. Munksgaard, et al. argued that the increase of family expenditure level is one of the main reasons for the growth of Danish CO₂ emissions in 2000 [3]. Indian families' household energy consumption accounted for 75% of the total energy consumption, and the increases in population,

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per capita expenditure and energy intensity are the driving factors in the growth of energy demand [4]. Based on Bin and Dowlatabadi's research, more than 80% of the total energy consumption and CO₂ emissions in the U.S were caused by consumer demand and the related economic activities in 2005 [5]. For South Korea, 52% of the primary energy consumption attributed to household needs in 2007 [6]. In terms of China, Wei, et al. believed that energy demanded by Chinese residents and its corresponding CO₂ emissions were as much as 26% and 30% of the total energy consumption and CO₂ emissions respectively in 2007 [7]. Household CO₂ emissions accounted for more than 40% of China's total CO₂ emissions produced by primary energy consumption in 2011 [8]. Wang, et al. pointed out that the alterations of Chinese family's lifestyles stimulate the increase of household CO₂ emissions significantly. Also, they reached the conclusion that urban families from the eastern coastal part of China have a much higher amount of CO₂ emissions than families in western inland in 2009 [9].

Textiles and clothing are important daily necessities for human beings. Usually, the consumption of these commodities causes large amount of CO₂ emissions. For example, CO₂ emissions generated by Americans' expenditure of clothing were approximately 150 Mt/y in 2004 [10]. According to Zeng, et al., apparel is one of the main sources of CO₂ emissions in Chinese urban families in 2012 [11]. There are typically four methodologies to study carbon footprint and CO₂ emissions, namely Input-output Analysis (I-O), Life Cycle Assessment (LCA), Carbon Footprint Models (CFM) and Consumer Lifestyle Approach (CLA) [12-16]. CLA links various consumer activities to economic activity, energy use and CO₂ emissions together. It is a consumer-oriented synthetical methodology to evaluate energy usage and CO₂ emissions. Consumer refers to an entity that purchase and consume products and services for personal or family motive. Lifestyle refers to the ways people would act under the impact of various consuming behaviors. The final purpose of CLA is to help government design better public policies by understanding consumers. CLA has been successfully utilized on a few research, for instance, Feng, et al. applied CLA to the study of relationship between Chinese residents' lifestyles and CO₂ emissions from domestic appliances, transportation, etc [17]. According to Zeng, et al.'s comments on the CO₂ emissions evaluation systems, the results of CLA-based research are comprehensive and accurate [11]. However, there has been few literature published investigating the CO₂ emissions during the domestic washing phase of clothes using CLA. Therefore, this paper chose CLA to investigate CO₂ emissions caused by domestics washing in Chinese household.

2 Methodology

2.1 CLA Framework

Regarding many interacting factors in consumer lifestyle, CLA attempts to offer an interdisciplinary framework, which explicitly acknowledges the multitude of interacting factors and groups these factors into five aspects: (1) External environmental variable, such as cultural influence and technological development; (2) Individual determinants: factors such as attitude and mentation can influence individual consumer's decisions; (3) Household characteristics: housing size and per capita income, etc; (4) Consumer choices, for example, the choice of an equipment or a service; (5) Environmental consequences of consumer activities, such as the consumption of energy, the production of CO₂ emissions, etc [5].

In this paper, the external environment is set to be urban China's general cultural and techno-