Available online at www.sciencedirect.com

ScienceDirect

Energy Procedia 104 (2016) 197 – 202

Energy Procedia

CUE2016-Applied Energy Symposium and Forum 2016: Low carbon cities & urban energy systems

Direct energy rebound effect of family cars: An analysis based on a survey in Chang-Zhu-Tan City Group

Fangjie Yu[a,b,*], Zhao Liu[a,b]

[a]Business School, Hunan University, Changsha 410082, PR China
[b]Center for Resource and Environment Management, Hunan University, Changsha 410082, PR China

Abstract

The energy rebound effect can inevitably affect energy saving as a result of improving energy efficiency. This paper investigates the use of family cars in the Chang-Zhu-Tan City Group. Based on the RP data, this paper firstly estimates the direct energy rebound effect of family cars in 2014. Secondly, the paper estimates the direct rebound effect within the context of Chinese policy, and further explores the factors which may affect the probability of rebound effect less than or equal to 0 by the binary logistic model. The results indicate that firstly, the average direct rebound effect is -25.47% in 2014. Secondly, taking the use of family cars in 2014 as a baseline scenario, the average direct rebound effect becomes 13.98%, and 55.31% of the rebound effect is less than or equal 0 under a scenario in which fuel consumption achieves 5.0L/100km. Thirdly, five family characteristics are identified as the factors which can significantly affect the sign of the rebound effect.

Peer-review under responsibility of the scientific committee of the Applied Energy Symposium and Forum, CUE2016: Low carbon cities and urban energy systems.

Keywords: Chang-Zhu-Tan City Group; Family cars; Direct energy rebound effect

1. Introduction

The rising number of family cars has increased fuel consumption, and brought great pressure to environmental conservation. With the emphasis on resource saving and environmental conservation, the Chinese Government have attached much importance to emission reduction and energy-saving of passenger cars. By adopting the fourth phases of mandatory fuel economy standard for passenger cars, the fuel consumption of new passenger cars is expected to reach 5.0L/100km in 2020. Improving energy efficiency has been widely recognized as an effective way of decreasing energy use, thus enhancing

* *Corresponding author. Tel.: +86-15700792892.*
E-mail address: 1159284318@qq.com

Peer-review under responsibility of the scientific committee of the Applied Energy Symposium and Forum, CUE2016: Low carbon cities and urban energy systems.
doi:10.1016/j.egypro.2016.12.034

energy supply security and reducing carbon dioxide emission [1]. However, improvements in energy efficiency have lowered the cost of energy services, and therefore, encouraged increased consumption of those services [2]. This so-called rebound effect may partially or completely offset the energy saved.

Chang-Zhu-Tan City Group is experimental area of resource-efficiency and environment-friendly society construction in China. Researches on energy rebound effect of family cars have helped improve experiences and lessons for its ecology civilization. On the other hand, Chang-Zhu-Tan City Group, being an important development area in central region of China, their study of energy-saving and emission-reduction helps assess the strategies for the rise of the central region. Therefore, the Chang-Zhu-Xiang City Group was chosen as the research subject. The main contributions of this paper involve, firstly, the introduction of a questionnaire to collect information regarding the use of family cars, secondly, the evaluation of the energy-saving effect caused by the improved energy efficiency through the estimates of the rebound effect, and thirdly, the recommendation of some feasible measures to save energy based on factors affecting the probability of the rebound effect less than or equal to 0.

2. Literature Review

(1) The estimates of the rebound effect for transport department

The estimates of the rebound effect for transport department can be defined from different perspectives. Firstly, the negative of the elasticity of energy demands with respect to energy price [3-5]. Secondly, the negative of the elasticity of energy services with respect to energy service price [6-8], and thirdly, the negative of the elasticity of energy services with respect to energy price [9].

(2) The rebound effect of family cars

Compared to the majority of energy services, personal automotive transport is relatively well-studied since data on vehicle travel and fuel consumption are routinely collected by national and regional authorities [10], and has become an optimal research direction for the rebound effect. Available documents have shown that most research have used regional or national statistical data to study the rebound effect. In addition, the rebound effect in less-developed economics is apparently higher than the developed areas. Furthermore, income [8], per capita consumption expenditure [11], refined oil product pricing mechanism [5], and vehicle traveled mileage [12] have significantly affected the rebound effect.

3. Methodology and Data

3.1 Methodology

Two methods were used to measure the energy rebound effect. Firstly, according to Steren et al.[13] and the RP data from the questionnaire survey, the model which aimed to estimate the rebound effect of family cars in Chang-Zhu-Tan City Group in 2014 is constructed as follows.

$$\ln(s_i) = c + \lambda_1 n_i + \lambda_2 \ln(\varepsilon_i) + \sum_{k=1}^{8} \alpha_k X_{ki} + \xi_i \tag{1}$$

Where c is a constant; λ_1 - λ_2 , α_1 - α_8 are parameters to be estimated; and ζ_i represents the random error term. s_i represents the initial energy service, and ε_i and n_i are the initial fuel efficiencythe number of cars the household owns respectively. Variables included in X are the number of individuals under the age of 18 and the following dummy variables: the head of household is a full-time job, with no spouse, holder of a master's degree or above, the age of the head of the household is over 30, the head of the household doesn't worried about the current ecological environment, the average monthly household income is above ¥12000, the shortest distance from the house to the city centre is above 2km. More importantly,