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博 士 学 位 论 文

能源回弹效应的理论演进与实证检验

The Theory Evolution and Empirical Study of  
Energy Rebound Effect

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## 摘要

无论是应对国际社会对低碳与温室气体减排的呼吁，还是缓解我国面临的能源、环境对经济发展越来越强的约束，节能减排都已经成为我国国民经济发展的重要议题。依据国内外节能减排的经验，各国都在积极鼓励技术革新，提高能源利用效率，促进节能减排，提高能源效率是实现节能减排的重要途径。然而，能源回弹效应这一现象告诉我们，技术进步不仅带来了能源产品使用效率的提高，也带来了整个经济体系的增长。经济增长对能源产品的需求增加，使得提高能源效率带来的能源消费量的节约被打了折扣。因此，从能源回弹效应这个角度来讲，经济发展对于节能减排实际上是一个负面作用力。但是对于中国这样的发展中国家，提高人民的生活水平是首要目标，保障经济发展是不可动摇的任务。那么如何在保持经济增长的前提下，实现节能减排是我国面临的真正任务。本文就我国宏观经济层面的能源回弹效应程度进行了测算，对于我国制定节能减排目标以及节能减的政策有重要参考价值。

随着我国向中等收入国家迈进，人均收入将不断提高，能源基础设施的可获得性增强，城镇居民将更加注重生活的舒适程度与便捷程度。生活的舒适程度与便捷程度的提高是人民生活水平提高的重要标志。在现代化社会生活中，这些标志的改善需要消耗更多的能源，进一步提高居民生活耗能。此外，随着城市化进程的深入，大量农村人口移居城市。这一部分”新增的消费者无疑将推高居民部门能源消费量。基于以上两个方面，中国居民部门能源消费量的上升空间仍然很大。因此，居民部门的节能减排越来越成为值得关注问题。本文也通过建立相关实证模型对我国居民部门的能源回弹效应进行实证测算。

在证明了我国宏观经济层面与微观经济层面均存在能源回弹效应后，本文尝试提出了抑制能源回弹效应的可能性方法，并在随后进行了实证检验。本文第六章关注焦点是中国居民电力价格对居民部门电力直接回弹效应的影响。计算了电价改革之前居民部门的电力回弹效应，然后通过政策模拟，研究执行阶梯电价后如何影响居民部门电力回弹效应。第七章研究对成品油定价机制如何影响居民交通服务的能源回弹效应。缩短调整周期和减小参考幅度的模拟情景下，在”权重

1:1:1, 7 天+2%”的调价规则下,出现了能源回弹效应的最小值(90.7%)。虽然通过实证研究证实了能源回弹效应的存在,改进能源效率对节能产生了负面作用,但是改进能源效率就“一无是处”了吗?在第八章,针对各种交通部门的节能技术,利用Money Metric 方法,计算能源效率提高对城镇居民福利的具体影响。结果显示能源效率的提高确实对居民福利具有正面影响。在人均263.5 元的投资成本下,可以获得553.5 元的福利收益,能源效率改进带来的福利收益远大于节能投资成本。

基于以上分析,我们对如何削弱我国宏微观层面的能源回弹效应,如何进行节能减排政策的选择,提出以下建议。首先,我国今后的节能减排政策不应当仅仅依赖技术与行政手段,还应当结合经济手段。其次,进一步加快能源领域的改革进程对于节能减排也是至关重要的条件。特别是合理能源价格体系的建立,从能源替代理论、改变消费者行为、促进可再生能源开发利用、引导节能领域投资等众多方面,都有改善提高节能效果。最后,政府应当尽可能为居民提供与家庭能源使用及环境相关的信息促进居民采用理性的能源消费以及环境影响行为。

**关键词：**能源回弹效应；节能；能源效率

## Abstract

Whether as the respond to international community's appeal to low-carbon and greenhouse gas emissions reduction, or to alleviate constraints from energy and the environment to Chinese economy development, energy saving and emission reduction have become to be an important issues for national economy development. According to experience on energy conservation and emission reduction domestic and overseas, most countries are actively encouraging technological innovation as well as promoting energy efficiency in order to achieve energy conservation. So enhancing energy efficiency is an important way to achieve energy saving and emission reduction. However, the existence of energy rebound effect tells us that technological progress has not only brought in the improvement of energy efficiency, it also pushes economy growth, which gives rise to the demand for energy products, so as to make energy savings brought by energy efficiency improvement be discounted. Therefore, from this perspective of the energy rebound effect, economy development for energy saving is actually a negative force. But for developing countries like China, to improve people's living standards is the primary goal and ensuring economic development is unshakable task. So how to achieve energy conservation and

emission

reduction in the premise of maintaining economy growth is the real task faced by our

country., This paper, we estimated the size of energy rebound effect on China's macro-economy level, which has important reference value on making energy conservation and emission reduction targets as well as corresponding policy.

China is stepping into the group of middle-income countries, per capita income will go up and availability of energy infrastructure will be enhanced. Households will

have higher requirement on comfort and convenience of daily life, which are important symbols of modern living standards and result in more energy consumption. In this regard, per capita income uprising will greatly stimulate the energy

consumption of household sector. In addition, China's ongoing urbanization drives

huge number of rural residents into cities. These increase consumers will undoubtedly

increase energy consumption of household sector. The two aspects mentioned above

manifest a huge potential of energy consumption growth in Chinese household sector.

Therefore, energy conservation in household sector would increasingly worth consideration. In this paper, we set up an LA-AIDS Model (Linear Approximation of

the Almost Ideal Demand System Model) to estimate the direct rebound effect for urban households in China, and real energy conservation effect of improving energy

efficiency is also obtained.

Since energy rebound both on macroeconomic and microeconomic level have been proved existing, we attempt to propose the methods to mitigate the energy rebound effect, and then empirical test are studied. In chapter 6, we calculate the rebound effect of residential electricity use before the residential tariff reform, and then carry out policy simulation to study how the implementation of increasing-block

electricity tariffs affects the rebound effect. In chapter 7, we carry out policy simulation to study how the reform of refined oil pricing mechanism affects the rebound effect. In the situation of shortening adjustment circle and reduction of reference range effectively mitigate the energy rebound. These two factors serve a

dual function on energy rebound whose minimum (90.7%) appears under the adjustment rules  $\omega_1:\omega_2:\omega_3=1:1:1$ ,  $\Delta P=7\%$ .

Now the energy rebound did exist, is the energy efficiency improvement good for nothing? In chapter 8, we calculate the money metric welfare value of residents to

imply the welfare effect of energy efficiency improvement. The result implies that

the welfare increase 458.1 Yuan on the cost of per capita 154.8 Yuan, which means the active impact of energy efficiency improvement on welfare.

Based on the above analysis, we put forward policy suggestion for mitigating the energy rebound effect, energy conservation and emissions reduction. Firstly, energy-saving policies for China can no longer rely on technology and administrative

means, should also be combined with economic means. Secondly, it is essential to speed up the reform process in the energy market for energy conservation and emissions reduction. In particular, from aspects of energy substitution theory,



changing

consumer behavior, and promoting renewable energy development and utilization,

guiding the energy saving investment, the establishment of the reasonable energy price system would improve energy saving effect. Last, the government should as far

as possible to provide residents information about household energy use and environmental in order to promote residents to adopt rational consumption behavior.

**Keywords:** energy rebound effect; energy saving; energy efficiency

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