Analysis on China's Recent Situation and Measurement of Energy Conservation and Emissions Reduction

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Abstract. The purpose of this study is to examine China’s approach to achieve energy conservation and emissions reduction. A questionnaire with rated response is designed to investigate people’s understanding and attitudes to energy conservation and emissions reduction. As climate change is more relevant to the next generation, two groups (the married and the unmarried) are compared in the survey, the findings indicate that the married couples pay more attention to the issue of carbon emissions. The author applies Likert scaling method to analyze the data. Results indicate that emotional attachment, budget constrain, loss averse and imposed risks can be used to explain why WTAC is much larger than WTP. China's carbon emissions have accounted for 24% of the world's carbon emissions since 2011, and that brings China great pressure to reduce emissions. Direct regulation, marked-based instruments such as taxes and subsidies, and low carbon economic development especially energy efficiency improvement as well as clean energy development are recommended to solve the issue of carbon emissions.

Introduction

With the rapid development of the world economy, climate change has a deep influence on human activities, and gets more attention from the international communities. According to Energy Information Administration, China's carbon emissions have accounted for 24% of the world’s carbon emissions since 2011. This indicates that China has been the largest carbon emitters and faces enormous pressure of energy conservation and emissions reduction. Developing low carbon economy is the preferred strategy of China to solve the issue of carbon emissions. This paper analyzes China’s recent situation of carbon emissions and people’s attitude towards emission reduction in order to examine China’s approach to achieve energy conservation and emissions reduction.

Literature Review

Since 1996, Knapp and Rajen[1] have used Granger causality test to explore the relationship between carbon emissions and population, the results show that there is no long-term co-integration relationship between them, but the population is the cause of the carbon dioxide emissions growth. A variety of methods are used to study the issue of carbon emissions, such as the input-output method, Log-Mean Divisia Index (LMDI) method, factor decomposition method and KAYA model. Zsofia Vetoe Mozner[2] applies input-output model to compare four countries’ (Germany, the United Kingdom, the Netherlands, and Hungary) extended trading activities and carbon emissions, reveals that consumption-based accounting is more reasonable and effective and the climate policy should base on the consumption-based principle. Based on LMDI method, Dong Feng[3] claims that China’s economic scale is the main factor of carbon emissions growth. Wang Chunhua[4] takes America and China as examples to analyze the influence factors of carbon emissions, the results reflect that “[U]nuneven growth across regions reduced carbon dioxide emissions in both countries”. In order to study the main characteristics of the dynamic competitions among energy, environment and economy, Pao HsiaoTien[5] applied Lotka-Volterra model. Their findings reveal that the coefficients of emissions from renewable energy and GDP are insignificant, so, commensalism (describes the relation between two different kinds, when one receives benefits from the other without damaging it) between renewable energy consumption and economic growth is significant,
which indicates that renewable energy consumption can enhance economic growth. Thus, it is recommended to develop renewable energy. Ratnakar Pani and Ujjaini Mukhopadhyay\(^6\), by using the method of management accounting and variance decomposition, research the global carbon emissions. The results reveal that compared to population, GDP growth has greater impact on carbon emissions, and the growing carbon emissions is closely related to the lack of energy management. According to Li Qi\(^7\), who studies the distribution difference of China’s energy footprint, the high marginal energy footprint mainly distributed in the middle east states of China, where are more developed than the western provinces and cities. Lin Boqiang\(^8\), a quite famous professor of energy economy in China, “analyze[s] the impact of China’s market-oriented reform on China’s regional energy and carbon efficiency”. The results indicate that marketization has significant positive effects on energy and carbon emissions, thus to adjust the energy price through the market would promote energy conservation and emissions reduction.

There are many researchers study the issue of carbon emissions based on macroscopic analysis, such as influential factors (GDP growth, population, energy intensity and carbon intensity). But the microscopic behavior research such as people’s understanding and attitudes to carbon emissions are rarely. In this paper, two aspects, macroscopic and microscopic, are applied to study the measurement of energy conservation and emissions reduction.

### Method

At present, carbon emissions data are not directly published by the Chinese Government, but according to the situation of energy consumption and consumption coefficient, the data can be calculated. According to Liu Hongguang\(^9\), a professor who put forward and improved carbon decomposition model, more than 90% of the carbon emissions are caused by fossil fuel consumption, so the carbon emissions calculation formula is:

\[
TC = \sum C_i = \sum \xi_i \theta_i E
\]

where \(TC\) represents carbon emissions produced by energy consumption, \(C_i\) represents carbon emissions produced by energy \(i\), \(\xi_i\) is carbon emission coefficient of energy \(i\), \(\theta_i\) is the proportion of energy \(i\) and \(E\) is total energy consumption (2008, p285-p287).

<table>
<thead>
<tr>
<th>Data source</th>
<th>Coal t(\text{C})/tce</th>
<th>Oil t(\text{C})/tce</th>
<th>Gas t(\text{C})/tce</th>
</tr>
</thead>
<tbody>
<tr>
<td>DOE/EIA</td>
<td>0.702</td>
<td>0.478</td>
<td>0.389</td>
</tr>
<tr>
<td>Japan’s energy economics research institute</td>
<td>0.756</td>
<td>0.586</td>
<td>0.449</td>
</tr>
<tr>
<td>National science and technology commission</td>
<td>0.726</td>
<td>0.583</td>
<td>0.409</td>
</tr>
<tr>
<td>project of climate change</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>0.728</td>
<td>0.549</td>
<td>0.416</td>
</tr>
</tbody>
</table>

Source: Hu Chuzhi, Huang Xianjin, Zhong taiyang & Tan Dan\(^{10}\).

The carbon emission coefficients are from the related research institutions, for example, the Department of Energy in Energy Information Administration (DOE/EIA). In this paper, the author takes the mean value of each carbon source’s emission coefficient (as shown in Table 1).

Based on the above formula and the energy consumption data collected from China Energy Statistical Yearbook 2013, China’s total carbon emissions from 2002-2012 are calculated. The total carbon emissions in 2002 was 100151.48t, and in 2012 was 220526.20t, which was more than two times of 2002. For the last 10 years, China’s carbon emissions have been rising constantly, which brings China a lot of pressure to reduce emissions. However, the energy intensity and carbon intensity in table 2 have declined during the past 10 years. Energy intensity generally means energy
consumption per unit GDP. And carbon intensity refers to carbon emissions per unit GDP. The statistics of GDP are from China Statistical Yearbook 2014.

The falling energy intensity and carbon intensity indicate that in the development of economy, the Chinese Government has paid attention to reduce energy consumption and carbon emissions at the same time. But the present situation is that China emits large amounts of carbon dioxide every year, which will intensify the greenhouse effect and cause climate warming. For China, developing low carbon economy is difficult but necessary.

In order to explore the Chinese method to achieve carbon emissions reduction, it is necessary to study people’s understanding and attitudes to carbon emissions. So, a questionnaire with rated response is designed. As climate change is more relevant to the next generation, two groups, the married and the unmarried, are compared in terms of their attitudes toward the question that who should be responsible for carbon emissions.

The Likert scaling method is used to analyze the questionnaires. Based on a limited sample of 10 married and 10 unmarried, it is found that, compared to the unmarried, the married couples concern more about the issue of carbon emissions. Most married couples are aware of the fact that China has been the largest energy consumer. Whether China should take the responsibility of energy conservation and emission reduction is debatable, only 60% agree or very agree. Though some of the respondents take a neutral attitude to whether the government has played a leading role in reducing emissions, more than a half are satisfied with the Government. It is suggested that carbon tax is a reasonable policy and energy prices should be market-oriented. Restrictions, energy-saving subsidies and pollution permissions are the widely known polices taken by the Chinese Government. 95% of the respondents don’t believe companies mitigate emissions actively.

It is easy to take for granted that the married couples care more about the next generation than the unmarried, which may lead the unmarried to believe that the emissions reduction should take the next generation into consideration. But based on this limited sample, almost all the married and the unmarried respondents believe that despite the long-term goal of energy conservation and emissions reduction, to achieve low carbon development should be initiated from the present generation. And 95% of the respondents indicate that in order to reduce emissions, they would like to change some of their behaviors such as green travel (travel by bike or on foot). 60% of the respondents claim that carbon emissions reduction should be preferred even if this will lead to economic decline and social issues such as unemployment, 20% take the neutral attitude between the economic development and emission reduction, while 20% claim that economic growth is more important. Compared with economic growth, people now pay more attention to environment pollution and climate change, which reflects that the extreme weather such as haze makes people begin to worry about the future of the world, and it is an urgent task to achieve energy conservation and emissions reduction.

In this paper, willingness to pay (WTP) will be taken to mean the maximum amount an individual or company would like to pay in order to receive environmental goods or improve environmental services. In contrast, the willingness to accept compensation (WTAC) will be considered to the minimum amount a person is willing to receive as a compensation for environment deterioration and climate change. In this limited sample, the differences of the preference between WTP and WTAC among the respondents are not significant. But the willingness to accept compensation for the loss of goods or services is three to ten times larger than the willingness to pay for the same goods or services.

First, the emotional attachment can be employed to explain this result. People may be emotionally attached to the existing climate because climate change may cause unpredictable disasters. The second explanation could be the budget constrain, the WTP is constrained by the person’s own budget for it is asked to contribute. However, in the situation of WTAC, this person received money as compensation, thus, it is constrained by the individual’s sense of others’ budget. The third explanation could be loss averse. Though it can be described as irrational, it is generally believed that people are loss averse, which means losing something is worse than gaining the same thing. So to make people feel the WTP is equal to the WTAC, the amount of WTAC should be much larger. The WTP can be considered as voluntary risks, which means taking the initiative to
pay for better climate environment for the next generation, and the WTAC can be considered as involuntary risks, which means imposing a worse climate environment on the next generation and offering them compensation in return, the difference between voluntary risks and involuntary risks can explain the big gap between WTP and WTAC. For example, it is assumed that a drunken man drives a car, gets into an accident, and loses his/her leg. He/She would feel bad. But it is supposed that the accident which gets his/her leg lose is caused by someone else who get drunk. He/She would feel worse. Both of the result is his/her leg is gone, no objective difference, but people feel differently\textsuperscript{[11]}. 

Summary
This paper studies the current situation of China’s carbon emissions and concludes that the total carbon emissions of China are tremendous. In spite of the declining energy intensity and carbon intensity, which means the Chinese Government has concerned with the issue of carbon emissions and taken actions to reduce carbon emissions, the constantly increasing carbon emissions brings China great pressure to reduce emissions. China’s total energy consumption has been more than two billion tce, and 70\% of which comes from the industrial sector. More than half of carbon emissions come from the burning of fossil fuels in energy-intensive industries, therefore, the related companies should take responsibility to mitigate emissions\textsuperscript{[12]}. And the Chinese Government should take direct regulation and marked-based instruments such as taxes and subsidies at the same time. According to the limited sample of 10 married and 10 unmarried, most respondents cared more about carbon emissions reduction than economic growth. Thus, the Chinese Government should enhance energy security and mitigate carbon emissions. The emotional attachment, budget constrain, loss averse and imposed risks are applied to explain why WTAC is much larger than the WTP, which proves that the task of energy conservation and emissions reduction should be the responsibility of the present generation, not the next generation. To develop low-carbon economy, it is recommended to implement sustainable energy policies. For instance, energy efficiency improvement and clean energy development should take priorities.

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References


