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A study on mitigation potential in service building sector: Efficient technology implications of China's Intended Nationally Determined Contribution

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Abstract

In 2015 China submitted its “Intended Nationally Determined Contribution” (INDC) to the United Nations Framework Convention on Climate Change (UNFCCC) in preparation for the Conference of Parties 21. China's INDC called for several low carbon actions toward 2030, and one of the important actions by 2030 in the China's INDC is to lower carbon dioxide (CO₂) emission per unit of GDP by 60% to 65% from the 2005 level. In this study, we concentrate in service sector and estimates CO₂ emission from six sub-sectors: office building, retail and store, hotel and restaurant, education, health care and others. Considering the gap of tertiary industry development and climate diversity across regions, we base our study on regional analysis and the study subject includes 31 provincial regions of mainland China. We first use a bottom-up cost optimization model called AIM/Enduse to evaluate the CO₂ reduction potential brought about by efficient technologies in China's service buildings. Then we design mitigation scenarios to examine the achievability of China's INDC as well as the efforts of service sector in achieving the CO₂ reduction target stated in China's INDC. The results show that the service sector has a certain potential to succeed a no-regrets CO₂ reduction target by 2030. For achieving China's INDC target, all six sub-sectors need implement more efficient technologies. Reduction rates vary across provinces due to climatic variations and different development statuses of tertiary industry.

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1. Introduction

China's economy has grown fourfold since its economic reform in 1978, and energy use has drastically increased in the process. Economic development in China relies on a coal-dominant energy mix, so energy-related GHGs emissions have grown even faster than energy consumption [1]. On June 30, 2015, China submitted its INDC to the UNFCCC in preparation for the Conference of Parties 21 to be held later that year in December. China's INDC called for several low carbon actions toward 2030, including a reduction of carbon dioxide emissions per unit of GDP by 60% to 65% from the 2005 level [2].

Energy use in service sector used to be small in China compare to other sectors (e.g. industry, transport). However, the energy use of service sector is particularly influenced by urbanization level. For instance, in Japan -- a highly urbanized Asian country, service sector counted for 17% of final energy consumption in 2010 [3]. However in Cambodia -- one of the least urbanized Asian countries, the service energy consumption only counted for 1% of final energy consumption in 2010 [4]. Figure 1 shows the energy consumption share [5] and urban population ratio [6] of China through the past decades. In 2010 the Chinese service sector counted for 3% of the total energy consumption. Due to the aggressive expansion of service building space, service energy consumption is expected to boom in the next few decades. Implementing mitigation plans in service building sector becomes an urgent issue.

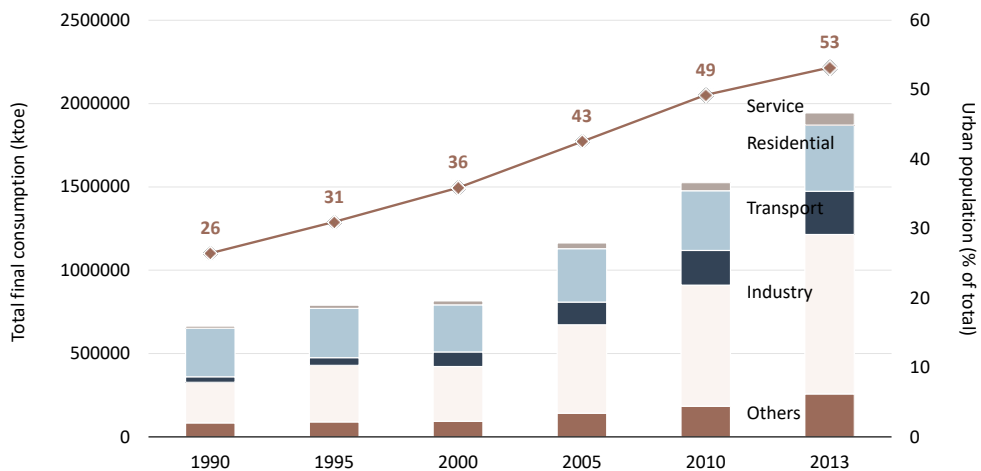


Fig. 1. Final energy consumption and urban population of China.

Up to now there is only a few studies focused on service sector of China. Most of the studies looked into the current energy use status in service sector. Peng et al. [7] collected energy use data of service buildings in six southern Chinese cities and analyzed the patterns based on building type, floor area and built year. Xia et al. [8] surveyed daily energy use in two Chinese commercial buildings and two American commercial buildings and carried out a comparison study regarding the commercial energy use in the two countries. Both of the studies focused on particular cities or buildings but didn't cover the entire service sector of China. Also their studies only concentrated on the current situation and did not provide future projection of service energy use. Zhou et al. [9] conducted a scenario analysis of energy consumption in China's service sector based on low carbon actions announced by China's 11th Five-Year Plan. However, their study overlooked the climate difference across regions and efficient level of energy technologies were considered as the same for all Chinese regions. In this study, we focus on service

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