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The Role of Industrial Parks in Mitigating Greenhouse Gas Emissions from China

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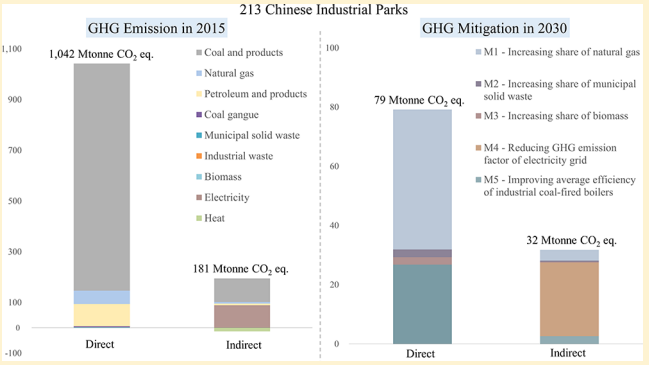
Supporting Information

ABSTRACT: This study uncovered the direct and indirect energy-related greenhouse gas (GHG) emissions of 213 Chinese national-level industrial parks, providing 11% of China's gross domestic product, from a life-cycle perspective. Direct emissions are sourced from fuel combustion, and indirect emissions are embodied in energy production. The results indicated that in 2015, the direct and indirect GHG emissions of the parks were 1042 and 181 million tonne CO_2 equiv, respectively, totally accounting for 11% of national GHG emissions. The total energy consumption of the parks accounted for 10% of national energy consumption. Coal constituted 74% of total energy consumption in these parks. Baseline and low-carbon scenarios are established for 2030, and five GHG mitigation measures targeting energy consumption are modeled. The GHG mitigation potential for these parks in 2030 is quantified as 111 million tonne, equivalent to 9.1% of the parks' total emission in 2015. The measures that increase the share of natural gas consumption, reduce the GHG emission factor of electricity grid, and improve the average efficiency of industrial coal-fired boilers, will totally contribute 94% and 98% in direct and indirect GHG emissions reductions, respectively. These findings will provide a solid foundation for the low carbon development of Chinese industrial parks.



1. INTRODUCTION

China is the largest carbon emitter, and it generated 9084 million tonnes of energy-related CO_2 emissions in 2014.[1] To address climate change issues, China promised to reach the CO_2 emission peak around 2030.[2] China has more than 2500 national and provincial industrial park,[3] which are the most important carriers of industrial sectors and contribute more than half of national industrial output.[4] As early as 2011, the Chinese central government started to attach great importance to low-carbon development of industrial parks.[5] The Ministry of Industry and Information Technology and National Development and Reform Commission jointly facilitated the low-carbon pilot industrial park program since 2013.[6,7] In 2014, an ambitious target of establishing 150 low carbon pilot industrial parks by 2020 was proposed in the national strategies on addressing climate change.[8] Moreover, in the grand plan of green development issued in 2016, the low-carbon transition of industrial parks was emphasized once more, and in particular, a number of parks were requested to reach the CO_2 emission peak first.[9] Thus, uncovering the features of the greenhouse gas (GHG) emissions of Chinese industrial parks will be critical to identifying the role of industrial parks in addressing carbon emissions reductions. Doing so will provide a robust foundation for decision making regarding the low-carbon transformation of industrial parks and the green development of industrial sectors in China.

The GHG emissions of several industrial park cases in China have been examined in previous studies,[10−12] and the GHG emission accounting methods of those parks mainly followed consumption-based principles[13] and employed the guideline issued by World Resources Institute.[14] In this guideline, GHG emissions are classified into scopes 1, 2, and 3. For an industrial park, scope 1 emissions refer to all direct GHG emissions within the park boundary, such as emissions from fuel combustion and industrial processes; scope 2 emissions refer to indirect GHG emissions embodied in outsourced electricity and heat, which is consumed inside the park but produced outside the park; and scope 3 emissions are other life-cycle emissions excluded in scopes 1 and 2, such as emissions from raw materials production outside the park. In the case study of Suzhou industrial park, scope 1 and 2 emissions are considered,[10,11] while in Beijing industrial park, scope 1 and 2 emissions and some important scope 3 emissions (from solid waste disposal) are considered.[12] Ban et al. estimated the scope 1 GHG emissions of 41 eco-

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