water and energy nexus in energy production: assessing water consumption and CO2 emissions of wind power in China

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Between 2002 and 2007, China's primary energy consumption increased from 1,482 million tonnes coal equivalence (Mtce) to 2,656 Mtce. At the same time, China's contribution to the global CO2 emissions increased from 14% to 21%. It is estimated that power generation accounts for more than half of the Chinese CO2 emissions. Many studies have been carried out on energy consumption and CO2 emissions during the life cycle of various power generation technologies, but there are very few studies focusing on China. Furthermore, in most of studies, the nexus between water and energy are ignored. Water consumption of power plants such as nuclear power plants and carbon capture and storage power plants which are considered as important alternatives to diversify the future power system in China is substantial. The choice of such water-intensive power generation technologies might exacerbate the challenge of water supply in water scarcity regions. Hence, it is indispensible to evaluate other environmental implications, in addition to carbon emissions, of various power generation technologies in order to achieve climate change mitigation objectives at national level as well as meet other environmental targets rather than shifting from one problem to another.

In this paper, we adopt input-output based hybrid life cycle analysis to evaluate water consumption of Chinese wind power. To the best of our knowledge, it is the first study to adopt IO based hybrid LCA to analyse the energy and water nexus in the Chinese power system. The most recent 2007 national IO table with 135 sectors and an 800kW wind turbine LCA data from EcoInvent are used in this analysis. China now has the largest wind power generation capacity in the world. Besides, 200 GW of wind turbines are planned to be installed by the end of 2020. Although wind power is considered as nil emission during its operation, the upstream emissions and water consumption should not be ignored. The results would help to understand the environmental impacts of wind power and also to provide quantitative evidence for the future energy planning in China.