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The tradeoffs and synergies between energy and water in wastewater treatment in China from nexus perspective

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ABSTRACT

Wastewater treatment is critical for water saving and secure water supply, but it is energy intensive. Over the past 10 years, the construction of national sewage treatment system is developing in high speed. By the end of 2018, 5370 waste water plants have been put into operation, covering 99.1 percent of cities and 95.5 percent of countries. The ratio of energy consumption for wastewater treatment to the total energy consumption in China has reached up to 2% which is still increasing. Meanwhile, the upgrading and reconstruction of the sewage treatment plants exert new pressure on energy consumption. Some studies has calculated the energy consumption for different wastewater treatment technologies mainly based on life cycle analysis (LCA) at micro level. However, few studies has focused on the whole wastewater treatment system at macro level, especially very few studies has analyzed the complex interaction between water saving and energy saving within the system. The potential tradeoffs and synergies are also rarely considered, which are critical for wastewater treatment planning. In this study, the nexus accounting framework for wastewater treatment is established to identify the key regions and technologies to boost synergies and avoid negative tradeoffs from nexus perspective. Taking China as a case study, firstly, energy consumption for wastewater treatment (EC) are systemically calculated based on LCA considering the technologies differences. The water return on investment (WROI) is defined and analyzed for wastewater treatment system. The regional differences among 30 provinces of WROI are investigated. The spatial and temporal characteristic of EC and WROI are analyzed based on ArcGIS and energy efficiency model. Finally, based on the characteristic of EC and WROI, a series of nexus indicators to show the spatial tradeoffs and synergies are defined. By analyzing nexus temporal and spatial characteristics, this study aims to provide theoretical basis for promoting sewage treatment upgrading and reconstruction as well as water and energy saving.

Keywords: Waste water treatment, energy-water nexus, energy efficiency, life cycle analysis

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