Co-benefit potentials of water conservation and energy saving from the life-cycle perspective: A study of iron and steel sector in China

Topic: Policy Analysis I
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Under the challenges of water and energy crisis, China is supposed to save water and energy simultaneously. The interactions between water saving and energy conservation have attracted more and more attention. In fact, once some measures which target saving energy are taken in industry, not only the embodied water footprint is saved as an ancillary benefit, but also the direct water demand may be changed, and vice versa. Existing literatures often addressed the embodied water/energy footprint in saved energy/water. However, few studies take into consideration the possibility that energy/water-saving technology can have auxiliary effects on water/energy use directly. This makes it challenging for policy makers to thoroughly understand how to manage water and energy conservation cooperatively.

To fill this gap, this study targets to assess the auxiliary effects on water use of energy saving, taking into consideration both the avoided embodied water use and the effects of energy-saving technologies on direct water demand. In this paper, iron and steel sector, the major intensive water and energy consumer in China, is taken as a case study. This study identified measures in iron and steel sector which have direct effect on both water and energy demand, and evaluated co-benefit potentials of water conservation and energy savings from the life-cycle perspective. The expert consultation and data from literatures support that switching iron and steel production process from BF/BOF to SC/EAF and applying technologies like Coke Dry Quenching (CDQ), Blast Furnace Dry Dusting (BFDD) and Converter Dry Dusting (CDD) can affect direct water and energy use simultaneously. Then in order to evaluate the co-benefit potentials of these technologies, this study combines input and output relationship and bottom-up analysis by disaggregating the iron and steel sector in the hybrid I-O table according to whether these measures are taken.

The results show that about 138 m3 water footprint and 5 kgce energy footprint will be saved per ton of iron production with 1% increase of SC/EAF routeâ€™s share. For CDQ, BFDD and CDD, when their popularization rates grow by 10%, the life-cycle water use decrease by 452kg/t, 30kg/t and 40kg/t separately, and the life-cycle energy use decrease by 1.2kgce/t, 2.5kgce/t and 0.056kgce/t separately. Compared to those technologies which can only save water or energy, these measures which save water and energy simultaneously are proved to be more efficient. In our scenario analysis, if the goal of iron production (0.77~0.82 billion ton in 2020) in China's 12th Five Year Plan is achieved, the scenario with more co-benefit potentials can save 20.32-21.64 million tce more energy and 809~861 million m3 more water from the life-cycle perspective than that with less co-benefit potentials, even though the direct water saving and energy saving are same.

This study provided an assessment tool to analyze the interactions between water saving and energy conservation comprehensively. This tool integrates the bottom up technologies with the relationship between various sectors in a production chain by disaggregating the hybrid I-O table. Although only the iron and steel sector was discussed in this study, the tool can be also extended to other sectors. Then more comprehensive understanding of water saving and energy conservation will be promoted, and have implications for policy decisions.