

SDWS2011.0651 Water-Energy Capital: Sustainability Implications Through the Implementation of Water Allocation in Tiam-Fr Energy Model.

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Abstract

Water and energy represent joint productions that support human welfare. We need water to produce energy and we use energy to clean and transport water. To deal with the anthropogenic pressure and climate changes, long-term solutions to water scarcity and energy demand needs to be developed. Studying the interconnections between water and energy sectors allows us to analyze and developing such strategies. The main aim of the study was first to estimate the exploitation, regeneration and management of water resources over long term horizons, and thereafter to anticipate or forecast development of the energy system under constrained water consumption to guarantee sufficient supply, regeneration and conservation. For this purpose we discuss the concept of Water-Energy Capital (WEC). It is adapted from the Natural Capital concept, with a view to creating economic incentives for water-energy nexus. The WEC is defined as a water sustainable consumption indicator through time, and enables us to estimate the energy footprint of water uses. Water allocation issues were implemented in the TIAM-FR (TIMES Integrated Assessment Model) energy system model, which is an bottom-up model offers a technology-rich representation of the energy systems in 15 regions of the world. It considers the long-term development of the energy system. All water uses were integrated in terms of a Water Reference Energy System detailing water consumption levels by different technologies. The proposed TIAM-FR model was used to optimize water allocation considering of opportunities for water reuse or non-conventional water use and to estimate the WEC. The water-scarce Middle East context was chosen as a case study. As the prospective model considers emissions of greenhouse gases, it may also be used to project the development of the energy systems and water allocation under the constraints of climate goals. Furthermore, constraints on water availability and energetic costs are also taken into account. Implementing water allocation in the TIAM-FR energy model has some sustainability implications. We determine an ecological economics framework in order to define the assumptions of our new concept of Water-Energy Capital (WEC). We develop long-term water-energy foresight exercises to assess an optimal "water-energy" mix through economical, social, and environmental points of view.