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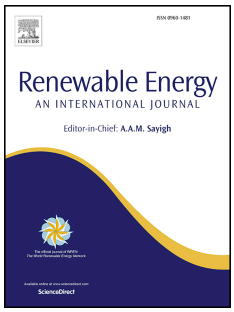

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William Hickman, Aramazd Muzhikyan, Amro M. Farid

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The Synergistic Role of Renewable Energy Integration into the Unit Commitment of the Energy Water Nexus

William Hickman[a], Aramazd Muzhikyan[b], Amro M. Farid[a,c,*]

[a]*Thayer School of Engineering at Dartmouth, 14 Engineering Drive Hanover, NH 03755, USA*
[b]*Masdar Institute of Science and Technology, PO Box 54224, Abu Dhabi, UAE*
[c]*Massachusetts Institute of Technology, 77 Massachusetts Avenue Cambridge, MA 02139, USA*

Abstract

In recent years, significant attention has been given to renewable energy integration within the context of global climate change. In the meantime, the energy-water nexus literature has recognized that the electricity & water infrastructure that enables the production, distribution, and consumption of these two precious commodities is intertwined. While these two issues may seem unrelated, their resolution is potentially synergistic in that renewable energy technologies not only present low CO_2 emissions but also low water-intensities as well. Therefore, renewable energy integration has the potential to address both sustainability concerns. And yet, renewable energy integration studies have yet to methodologically consider an integrated energy-water infrastructure. Many of these works rely on a coupled unit commitment-economic dispatch simulation. Recently, a simultaneous co-optimization method has been contributed for the economic dispatch of networks that include water, power, and co-production facilities. This paper builds upon this foundation with the development of the corresponding unit commitment problem. It demonstrates the optimization on several case studies inspired by Singapore & the Middle East. It concludes that renewable energy simultaneously reduces CO_2 emissions and water withdrawals. Furthermore, it shows how water storage can help alleviate binding co-production constraints, flatten production profiles and reduce production cost levels.

Keywords: Energy-Water Nexus, Renewable Energy, Renewable Energy Integration, Desalination, Energy Storage, Unit Commitment

1. Introduction

1.1. Motivation

Renewable energy integration has been the subject of significant concern within the context of global climate change[1] and the need to curb CO_2 emissions. Consequently, many governments have enacted policies to directly support their technological integration into the electrical power grid[2–6]. Nevertheless, solar photovoltaics (PV) and

*Corresponding author
Email addresses: william.w.hickman.16@dartmouth.edu (William Hickman), amuzhikyan@masdar.ac.ae (Aramazd Muzhikyan), amfarid@dartmouth.edu,amfarid@mit.edu (Amro M. Farid)