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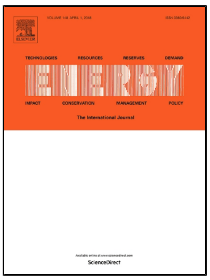

A Stochastic Integrated Planning of Electricity and Natural Gas Networks for Queensland, Australia Considering High Renewable Penetration

Juliana Barbosa Nunes, Nadali Mahmoudi, Tapan Kumar Saha, Debabrata Chattopadhyay

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A Stochastic Integrated Planning of Electricity and Natural Gas Networks for Queensland, Australia Considering High Renewable Penetration

Juliana Barbosa Nunes[1], Nadali Mahmoudi*, Tapan Kumar Saha, Debabrata Chattopadhyay
School of Information Technology and Electrical Engineering
The University of Queensland, Brisbane, Australia
* The University of Queensland, St. Lucia, Qld-4072, Australia, Tel: +61 7 33653573, Fax: +61 7 33654999

j.barbosanunes@uq.edu.au, n.mahmoudi@uq.edu.au, saha@itee.uq.edu.au, dchattopadhyay6@gmail.com

Abstract- This study develops a long-term integrated planning approach to electricity and gas aiming at economically optimizing the 2030's investments of both networks while considering new policies towards future clean energy. A static stochastic cost minimization model is formulated, which takes into account the short-term uncertainties of renewable power, i.e. wind and utility-scale solar photovoltaic (PV) as well as the long-term uncertainties of load growth and gas price. The equivalent networks of both electricity and gas are driven to accurately capture their existing supplies and transmission networks. In addition, the integrated planning model allows determining the location of new power plants and gas supply facilities with their optimized capacities, as well as new transmission lines and pipelines. An extension of the proposed scheme is considered to accommodate higher penetrations of renewable energy and assess their impacts on both systems. The proposed model is applied to the state of Queensland in Australia, which is a prime example of a region actively integrating electricity and gas.

***Index Terms*— Electricity network, gas network, high renewable energy penetration, long-term integrated planning, stochastic optimization.**

1. INTRODUCTION

1.1. Background, Motivation and Approach

Environmental concerns have caused governments worldwide to establish new policies to reduce carbon emissions, which have encouraged a shift towards lower carbon technologies. In electric power systems, this movement has been observed with the

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