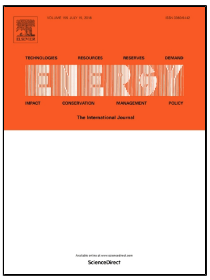
Accepted Manuscript



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PII:	S0360-5442(18)31172-1
DOI:	10.1016/j.energy.2018.06.107
Reference:	EGY 13149
To appear in:	*Energy*
Received Date:	16 January 2018
Accepted Date:	16 June 2018

Please cite this article as: Yingzong Liang, Chi Wai Hui, Convexification for Natural Gas Transmission Networks Optimization, *Energy* (2018), doi: 10.1016/j.energy.2018.06.107

Convexification for Natural Gas Transmission Networks Optimization

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June 19, 2018

Submitted to *Energy*

Abstract

Natural gas transmission is energy consuming due to significant pressure loss during the transportation process. Despite considerable effort to reduce its energy consumption in optimization study, the nonconvex behavior of mathematical models, mainly resulted from nonconvex pressure drop constraints, have made the problem challenging to tackle. To address this issue, this paper presents two convex formulation techniques to convexify the pressure drop constraints. The techniques use logical constraints to handle unknown gas flow direction to avoid absolute values and bilinear terms in the constraints. Modeling techniques are also presented to reformulate nonconvex compressor constraints into convex/concave ones. The proposed techniques are applied to two different scale natural gas transmission networks. Computational results suggest that the convexification relieves the models from local optima, and greatly improves solution quality and solution efficiency.

Key words: natural gas transmission networks; energy minimization; convexification.

1. Introduction

Natural gas is the premium fuel for the 21st century for its low emission [1], high energy efficiency [2], abundant resources [3], and robust production [4]. Today natural gas accounts for 23% of primary energy consumption of the world, and its consumption is projected to increase by 69% from 2015 to 2050, making up the largest share of primary energy growth [5]. In spite of its

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