

The Scenario Analysis of Shale Gas Development in China by Applying Natural Gas Pipeline Optimization Model

Authors : Meng Xu, Alexis K. H. Lau, Ming Xu, Bill Barron, Narges Shahraki

Abstract : As an emerging unconventional energy, shale gas has been an economically viable step towards a cleaner energy future in U.S. China also has shale resources that are estimated to be potentially the largest in the world. In addition, China has enormous unmet for a clean alternative to substitute coal. Nonetheless, the geological complexity of China's shale basins and issues of water scarcity potentially impose serious constraints on shale gas development in China. Further, even if China could replicate to a significant degree the U.S. shale gas boom, China faces the problem of transporting the gas efficiently overland with its limited pipeline network throughput capacity and coverage. The aim of this study is to identify the potential bottlenecks in China's gas transmission network, as well as to examine the shale gas development affecting particular supply locations and demand centers. We examine this through application of three scenarios with projecting domestic shale gas supply by 2020: optimistic, medium and conservative shale gas supply, taking references from the International Energy Agency's (IEA's) projections and China's shale gas development plans. Separately we project the gas demand at provincial level, since shale gas will have more significant impact regionally than nationally. To quantitatively assess each shale gas development scenario, we formulated a gas pipeline optimization model. We used ArcGIS to generate the connectivity parameters and pipeline segment length. Other parameters are collected from provincial "twelfth-five year" plans and "China Oil and Gas Pipeline Atlas". The multi-objective optimization model uses GAMs and Matlab. It aims to minimize the demands that are unable to be met, while simultaneously seeking to minimize total gas supply and transmission costs. The results indicate that, even if the primary objective is to meet the projected gas demand rather than cost minimization, there's a shortfall of 9% in meeting total demand under the medium scenario. Comparing the results between the optimistic and medium supply of shale gas scenarios, almost half of the shale gas produced in Sichuan province and Chongqing won't be able to be transmitted out by pipeline. On the demand side, the Henan province and Shanghai gas demand gap could be filled as much as 82% and 39% respectively, with increased shale gas supply. To conclude, the pipeline network in China is currently not sufficient in meeting the projected natural gas demand in 2020 under medium and optimistic scenarios, indicating the need for substantial pipeline capacity expansion for some of the existing network, and the importance of constructing new pipelines from particular supply to demand sites. If the pipeline constraint is overcome, Beijing, Shanghai, Jiangsu and Henan's gas demand gap could potentially be filled, and China could thereby reduce almost 25% its dependency on LNG imports under the optimistic scenario.

Keywords : energy policy, energy systematic analysis, scenario analysis, shale gas in China

Conference Title : ICEPDM 2015 : International Conference on Environmental Policy and Decision Making

Conference Location : Zurich, Switzerland

Conference Dates : July 29-30, 2015