

Study on Multi-lateral Trades of Natural Gases between Export
and Import Countries in the East Asian Region using Multi-Agent
System Approach

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Abstract

Introduction

Despite all the concern about the coming of the oil peak as they say, oil is still a principal primary energy now. On the other hand, natural gas is now emerging an upturn direction for the world energy demand because of the global climatic change constraints caused by CO₂ emission.

Especially in the Asia and Oceania region including our country Japan, it was forecasted by IEA experts in World Energy Outlook 2008 that the demand of primary energy in 2030 would increase by 45% with average annual rate of 1.6% from the present demand of 11.73 billion tones oil equivalent. It was remarked that about a half of such energy increment should be occupied by China and India. Therefore, the situation of energy trades in the Asia and Oceania region, maybe involving Middle East suppliers, becomes further complicate from now on, and it may be difficult for energy importers to secure satisfactory supply amount at the less expensive prices.

Moreover the international trades of energy resources must be carried out in future under those constraints such as due to environmental protection, the stable energy supply scheme with less risk and lower price stability. Therefore it is very important to evaluate the impact of those factors.

To the future goal of our energy study, we would like to formulate a complex matrix model for the multi-lateral trades via various ways of transports such as pipelines, tankers, trains and motor trucks etc. with respect to various fossil energies such as oils (conventional crude oil and products, NGL, LPG, heavy, extra-heavy and GTL), natural gases (pipeline NG, LNG, NGH, CBM and other unconventional gases) and coal (high grade and low grade) between the export and the import countries.

However, at the present paper we would like to discuss first on fundamental concept of Multi-Agent System Approach which is applied for the multi-lateral trades of energy commodity, then we carry out simulation of “Satisfaction rating” for each participating country as an agent using the multi agent model for the supply and demand stabilization of natural gases in the East Asia region. Then we introduce preliminary formulation of a prototype model for the multi-lateral trades

of natural gases (pipeline gas, LNG, CBM, and others such as NGH/CNG for marginal gas fields and unconventional gases) particularly in the East Asian region.

Finally we demonstrate a test calculation for predicting most likely forecast of optimized energy amount movements between export and import countries.

Methodology

The methodology giving an optimal answer, which maximizes or minimizes the utility function of an intended full system, has been applied in order to solve the issues containing complicate factor such as “the tri-lemma problem”. However, it is thought that there is a better method to clear up the issues, where an answer to them can be obtained by evaluating the satisfaction rating on the clashing speculation of each agent and the decision-making based on attributive information or narrow outlook. We considered of making a model oriented to the multi-agent system for simulating multi-lateral trade of natural gases, which bears such complex and entangled factors. By applying this method, we can clear how the constituent factors of a whole system and their mutual interactions have an impact on itself without breaking it into parts. We assume exporters and importers of energy commodities as each agent in developing a multi-agent system.

Firstly, we present our previous study on predicting forecasts of the bi-lateral trade of natural gases in Asian countries from a viewpoint of stability of price and supply using the genetic algorithm (GA). We could get to know more about the long-term tendency of natural gas trades in eastern Asian countries. The shortage of natural gas supply would never arise in East Asia to 2030, if complimentary relationships between exporters and mutual concession of importers would be maintained. But, it was thought that if demand of natural gases of importers would increase substantially, such situation will create competition in securing natural gases between importers. It will be more important for each importer to build up the mutual concession. It can be said that they feel a glowing need to run the lighthearted simulation on the multilateral trades of energy resources containing natural gases.

Secondly, we demonstrate how the changes of element parameters reflect to the flow transaction of natural gases trades by using a multi-agent system, and following results were confirmed. An optimization of whole intended system is to maximize environmental, energy consumption and economic growth of it, and satisfaction level of each agent is to maximize stable production, stable occupation and increased consumption of natural gases. The best answer of the former does not always conform to the best answer of the latter. This method may reflect such decision making process correctly in order to know of a way satisfying each agent, and has a possibility to search a cooperation scenario satisfying each agent.

It is expected that multilateral trades in East Asia, where will enjoy an increasing demand of natural gases, will be carried out effectively for each other in future. This method will be useful for following attempts.

- 1) To formulate a strategy of trade assuming the behavior of other agents.
- 2) To rank each factor by magnitude of its impact.
- 3) To make an economic policy.
- 4) To know easily about the effect of each factor by a deskbound experiment.

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