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ANALYSIS

A global energy outlook to 2035 with strategic considerations for Asia and Middle East energy supply and demand interdependencies

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ABSTRACT

This study quantitatively projects energy supply and demand in Asia and other regions of the world through 2035, focusing on the relationship between Asia and the Middle East. An integrated group of energy economics models, including a macroeconomic model, an energy supply and demand model and a technology assessment model, are used to show that the Middle East will be able to respond to an expected substantial increase in Asian fossil fuel demand. Therefore, continuing appropriate investment in resource development in the Middle East will be indispensable to ensure stability in global energy supply and demand. The Middle East is expected to focus more on its fossil fuel exports to Asia amid a decline in exports to North America and Europe. The large energy consumption and production regions are expected to become more and more interdependent.

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1. Introduction

Global energy demand has been expanding rapidly; it expanded 2.4-fold from 5000 million tons of oil equivalent (Mtoe) in 1971 to 11,700 Mtoe in 2010. The Asian region has increased its energy demand remarkably over recent years, accounting for 70% of the growth in global energy consumption since 2000. The rapid energy demand expansion in the region, poor in oil and natural gas resources, has caused major problems in and outside the region. For example, China, with the largest energy demand in the world, has taken all possible measures to secure and diversify its fossil fuel procurements, including constructing international oil pipelines, acquiring overseas oil interests, and expanding Liquefied Natural Gas (LNG) and pipeline-based natural gas imports, while introducing more nuclear and renewable energy. Energy demand, particularly fossil fuel demand, is predicted to continue expanding in the world including Asia. How the unevenly distributed fossil fuel resources will be provided to the points of demand, in a stable manner, is expected to become an increasingly important challenge.

Energy demand is also increasing in the Middle East. Demand growth in this region requires attention because it can undermine the export capacity needed to meet the growing demand in other regions, including Asia. For example, the Middle East consumed only 4% of its domestic oil production in 1971, but the ratio rose to 24% by 2010. As the energy demand in this region is expected to continue its rapid growth in the future, expanding the production to maintain the export capacity becomes a crucial issue for the future global energy supply.

Global energy demand projection has been performed by many organizations, including the International Energy Agency (IEA) [1], U.S. Energy Information Administration (EIA) [2] and the Organization of the Petroleum Exporting Countries (OPEC) [3]. There are similarities and dissimilarities, reflecting the different viewpoints and assumptions. For example, IEA's long-term oil demand projections have always been lower than those of OPEC and U.S. EIA for both Asia and the World, resulting in smaller oil production forecasts. But they agree in the view that in the central cases (IEA's New Policies Scenario (NPS), OPEC's Reference Case and U.S. EIA's Reference Case), global and Asia's fossil fuel demand shows a continuing growth, requiring a steady growth in production.

BP's outlook [4] has a different view of the Middle East's future crude oil production when compared to the other outlooks. According to BP, due to a slump in global oil demand and an increase in unconventional non-OPEC oil supply, oil production from OPEC will decline in the next decade. If this is true, it will greatly affect the financial situation of the Middle Eastern oil exporting countries. In the longer term, however, BP forecasts that global oil demand will surge again to surpass the increase in unconventional oil production, and oil production growth from the Middle East will be back by 2030 to reach a level 30% larger than that in 2010.

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To sum up, different outlooks have different backgrounds and assumptions, but they broadly share the same vision. Demand for fossil fuels, especially oil and natural gas, will continue to grow in the future mainly in non-OECD countries in Asia. The Middle East will play a key role to increase production to meet the growing demand. Unconventional supplies will expand mainly in North America, but demand for conventional oil and natural gas from the Middle East will increase in the long term.

But some questions arise: Will the increase in exports to Asia be strong enough to sustain the economic growth of the Middle Eastern countries? What are the possible impacts of unconventional resources development in Asia as well as in North America? What happens if Asian countries take strong actions towards low-carbon societies and reduce fossil fuel consumption? What are the differences between the future evolution of crude oil and natural gas exports to Asia? As an attempt to answer these questions, we analyzed in this study the future energy supply and demand situations up to 2035, making use of a group of numerical models. This study focuses on the relationship between Asia and the Middle East in order to draw the implications for the fossil fuel exporting countries. Based on thorough reviews of the latest energy policies this study also provides detailed projections, especially for energy demand in Asian countries.

The Fukushima Daiichi nuclear power plant accident triggered by the Great East Japan Earthquake in 2011 led to changes in nuclear policies in Japan and other countries, which will greatly affect future fossil fuel demand. These latest policy changes are not always fully reflected in the outlooks mentioned above. For example, the latest version of U.S. EIA's International Energy Outlook (IEO) was published in September 2011, and it forecasts Japan's nuclear power generating capacity to increase from 48 GW in 2008 to 55 GW in 2020 and 61 GW in 2035 in the Reference Case. New nuclear power plant (NPP) construction in the near future, however, is no longer realistic in Japan, as the government has announced its intention to reduce dependence on nuclear energy [5].

IEA's NPS assumes 70 GW nuclear capacity in 2020 in China, presumably based on the nation's most ambitious target that has ever been announced. The Chinese government, however, stopped granting licences for new NPP construction for more than one year and a half, in the wake of the Fukushima accident. This will cause a delay in nuclear power development. According to the media [6], China now sets the target at 58 GW in 2020, instead of 70 GW. Since most of the planned new NPPs are already under construction and granting licences for starting new ones has been resumed, there will be no problem for meeting the new target of 58 GW. A total of 70 GW by 2020 should be regarded as unrealistic.

In this study we reviewed thoroughly the latest energy policies of each country as well as the global energy supply and demand situation, and made detailed projections especially for Asian and Middle Eastern countries. Our Reference Scenario (described below) proposes an outlook for the future energy supply and demand situation in line with past trends, unlike IEA's NPS. Our Advanced Technology Scenario assumes the maximum diffusion of energy saving and CO_2 reducing technologies, but is not as ambitious as IEA's 450 Scenario, which is a sort of backcast from the target of halving global GHG emissions by 2050. Based on these two scenarios, we analyzed future energy situations on a country-by-country basis, especially focusing on Asian and Middle Eastern countries and the developing relationship between them.

2. Methodology and assumptions

2.1. Methodology

In this study, we built and used an integrated group of energy economics models including a core econometric model to analyze long-term energy supply and demand comprehensively and consistently. The integrated group consists of three submodels — a macroeconomic model, an energy supply and demand model, and a technology assessment model. The last one includes the automobile model, the buildings sector energy consuming equipment model and the renewable energy introduction model. Fig. 1 indicates the entire picture of the model group.

In the integrated group of models, the world is divided into 45 regions in accordance with geopolitical factors and region-by-region energy supply and demand structures as follows:

Americas: United States, Canada, Mexico, Brazil, Chile and Other Latin America.
Europe: United Kingdom, Germany, France, Italy, Other OECD Europe and Non-OECD Europe.
Former Soviet Union (FSU): Russia, Kazakhstan, Azerbaijan, Uzbekistan, Turkmenistan and Other FSU.
Africa: South Africa and Other Africa (including North African countries such as Egypt, Libya, Tunisia, Algeria and Morocco).
Middle East: Saudi Arabia, Iran, Iraq, United Arab Emirates, Kuwait, Qatar, Oman and Other Middle East (including Bahrain, Israel, Jordan, Lebanon, Syria and Yemen).
Oceania: Australia and New Zealand.
Asia: Japan, China, India, Taiwan, South Korea, Hong Kong, Indonesia, Malaysia, Philippines, Thailand, Vietnam, Singapore, Brunei, Myanmar and Other Asia.

For the purpose of analyzing Asia and the Middle East in detail, Asia is divided into 15 economies and the Middle East into eight economies. The projection period is between 2011 and 2035.

2.1.1. Macroeconomic model

The macroeconomic model consistently calculates gross domestic product components (demand items) under a set of assumptions for crude oil prices, and domestic economic, fiscal and monetary policies. It also estimates indicators including the vehicle fleet (passenger and freight vehicles) and other transportation indicators, crude steel output and other production indicators, and prices that directly and indirectly influence energy demand.

2.1.2. Energy supply and demand model

The energy supply and demand model is the core model for the analysis. The IEA's energy balance tables [7,8] are adopted as basic

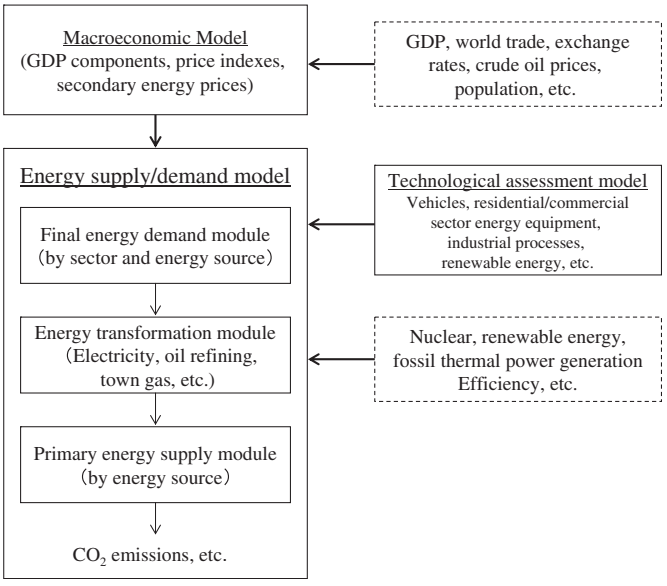

Fig. 1. Model structure

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