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A thought on Structural Changes in the International Energy Market and the Role of Innovations

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International energy markets are always exposed to changes. Energy demand changes from moment to moment depending on economic conditions, industrial activities and human livelihoods. To meet changing demand, energy is provided through the supply chain from the upstream sector for resources development to the downstream sector for delivery to final consumers. However, supply is also forced to change depending on national policy and strategic decisions on production, business decisions based on profitability and economic efficiency, weather and other natural conditions, and unexpected events or accidents. In this way, energy supply and demand always change, with energy prices fluctuating. This represents the normal state of international energy markets.

International energy markets also see frequent structural changes. As energy demand growth has continued to differ by region or country due to economic growth and development gaps, structural energy demand changes have occurred. Although developed countries accounted for more than 70% of global energy consumption a half century ago, the share has slipped below 50%, with the gravity center of global energy demand shifting to developing countries including Asian countries. On the supply side, energy supply had centered on coal since the industrial revolution until the 20th century became the century of oil in which automobiles diffused rapidly. Since the two oil crises, however, mainly developed countries have promoted the development of alternatives to oil, leading nuclear, natural gas and renewable energy to take key positions.

Characteristically, the abovementioned structural changes in international energy markets take relatively longer time. Such changes may be described as evolution. Various factors exist behind the time-consuming structural changes, including the effects of infrastructure and capital investment and stock that are unique to energy markets. Changes are seen from the viewpoint of flow and stock. While daily changes as flow are big, facilities developed as stock through infrastructure and capital investment for the whole of international energy markets are too large in scale to easily change. Large oil, gas and coal fields, liquefied natural gas facilities, power plants and power transmission/distribution networks are used over more than 20 years. In a sense, the international energy market supply chain cannot be flexible or agile.

Nevertheless, the accumulation of large daily changes or flow would exert greater influence as time goes by. Such accumulation in the past has brought about energy transitions. As noted above, typical energy transitions include those from the coal century to the oil century and from oil to oil substitutes and diversification via the oil crises in the 1970s.

Recently, international energy markets have seen another great structural change. That is the shale revolution. U.S. shale resources had been known as unavailable for commercial production

before the revolution. Through a combination of advanced technologies such as horizontal drilling and hydraulic fracturing, the application of information technology and the IT-based optimization, huge shale resources have become available for commercial production, bringing about a revolution that has dramatically changed U.S. energy supply and demand, the international energy situation, international relations and geopolitics. The shale revolution is still a key factor exerting great influence on the current international energy situation that is changing dramatically due to the COVID-19 pandemic.

As indicated by the shale revolution, cutting-edge or innovative technologies play a key role in bringing about a major structural change in the international energy situation. The development and diffusion of cutting-edge or innovative technologies or the rapid diffusion of long-existing but not-widely used technologies could lead energy markets to change more rapidly than in the past or go in a different direction. Such change is difficult to predict and may be identified only when it emerges. The shale revolution was a typical event that was difficult to predict. In such event, the market experiences a discontinuous change caused by new technologies.

In anticipation of the future international energy situation after the current rapid changes, people in the world today are increasingly interested in structural changes that could be caused by cutting-edge or innovative technologies. Due to great uncertainties brought about by the COVID-19 disaster, the direction in which the world or the global energy market would go has become a matter of great interest. How decarbonization, a challenge that had attracted global attention before the pandemic, would influence the development and diffusion of cutting-edge or innovative technologies is now attracting global attention in the new context of the relationship between the post-coronavirus economic recovery and decarbonization. Developments in the past several years indicate that great hopes regarding decarbonization are undoubtedly placed on renewable energy, whose costs have declined rapidly. As renewable energy has diffused, various cutting-edge technologies to address the intermittency of renewable energy supply have attracted great attention. They include storage batteries, CO_2-free hydrogen produced with surplus electricity from renewable energy, and cutting-edge digital or IT technologies. Representative long-term energy outlooks in the world anticipate the substantial expansion of renewable energy almost commonly, indicating that renewable energy expansion would exert great influence on the global energy situation.

In considering the future energy transition, meanwhile, we are still uncertain about what would be a main actor. Innovative technologies on which great hopes are placed include not only renewable energy but also carbon capture and storage, carbon capture and utilization/storage, CO_2-free hydrogen production using fossil fuels, and next-generation nuclear power generators, etc. As what technology option would be a winner is uncertain, we must choose between pursuing as many options as possible and betting on one option in view of various conditions. Anyway, however, a player acquiring central innovative technologies to promote structural energy market changes and energy transition could gain a competitive advantage regarding the balance of power in future international politics, economy, geopolitics and energy markets. Competition for innovative technologies will become a challenge for success or survival for major countries including the United States, China and European countries as well as Japan and for the international business world.

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