Pushing and Pulling for Innovative Technology

Policy measures to tackle global warming need to emphasize technological development and diffusion, writes Yamaguchi Mitsutsune.

The previous article in this column (TJJ Jun.) explained how difficult it is to halve the global emission of greenhouse gases (GHGs) from the present level, citing specific reduction percentages for developed and developing countries as examples. However, the concentration of GHGs will not stabilize if the emissions continue to increase, so a significant reduction in emissions will be needed in the future. Would reduction be possible, then, if a numeric target were set through international negotiations, for example, a reduction of x% by 2050? The answer is no. Technological innovation and the deployment of such technologies are essential for a large-scale reduction. Let me illustrate this point with some simple equations.

Equation (1) below is an identity.

CO_2 emissions = (CO_2 emissions/GDP)× GDP (1)

Equation (2) is obtained by differentiating the equation (1) above.

$\Delta CO_2/CO_2=\Delta(CO_2/GDP)\div(CO_2/GDP)+\Delta$ GDP/GDP (2)

This means that the rate at which CO_2 changes is the sum of the rate of change in CO_2 emissions per GDP and that in GDP. The former includes both the conversion to fuels of low carbon content, such as natural gas (or to non carbon fuels, such as biomass) and energy efficiency improvement through technology diffusion. Here, these factors are collectively referred to as "the ratio of technological improvement." In this equation, technological improvement and/or slower GDP growth can help achieve CO_2 reduction.

The average ratio of technological improvement in the world from 1970 to the present, during which data are available, is 1.23%. The moderate scenario of the Intergovernmental Panel on Climate Change (IPCC) assumes the average GDP growth ratio to 2100 to be 2.76% (SRES B2 scenario). Taking this assumption, an attempt was made to obtain the ratio of technological improvement as well as GDP declining ratio necessary for halving CO_2 emissions by 2050 compared to 1990. The results indicate that the average annual ratio of technological improvement needs to be 3.86% if the effects on the GDP are to be eliminated. The results also indicate that GDP would decline by as much as 80% (from its business as usual level) if the conventional ratio of technological improvement were maintained. Politicians are not likely to choose the latter alternative, so there is no choice but to strive for further technological improvement if we are to minimize the adverse effects on our lives. This indicates that emissions would not decrease simply by placing a cap on global emissions, but rather, that reduction would be possible only within the scope attainable by technological improvement. Even though impact on GDP is unavoidable to some degree, a decline of 20% to 30% is not likely to be acceptable. In this context, the Government of Japan adopted, in March of this year, the initiation of development work by selecting twenty-one priority technologies in both energy supply and demand, as a part of the Cool Earth - Innovative Energy Technology Programme.

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In view of the above, a policy should be evaluated focusing on whether it promotes technological development and deployment. Incidentally, there are two different ideas for policy measures to promote technological innovation. One is technology-push and the other is demand-pull. The former advocates the idea that government support is needed especially in the initial stages of technological research and development, with a focus on basic studies and applications. Japan and the United States are inclined toward this idea. (In fact, the government budget for energy-related research and development of both countries far exceeds that in European countries.) The latter demand-pull advocates the idea that technological innovation in the private sector is best promoted through the strengthening of regulations. This is a mainstream idea advocated by European nations. In reality, both approaches are needed.

In the case of the electric power generation sector in particular, the product itself (electricity) is invisible so competition is possible only in terms of price. Those making an enormous amount of investment in this field are taking the considerable risk of possible failure, while success would bring benefits to their competitors. If investment were made only by the private sector, the investment would inevitably be insufficient. On the other hand, the private sector is capable of facilitating progress in technological innovation, as seen, for example in the case of home appliances, where consumers show willingness to purchase new attractive products such as LCD TVs despite the higher price tag attached. Looking at it this way, the roles performed by government-led research and development are significant when addressing the global warming issue.

Finally, concerning the strengthening of policies and measures, there are many directions to consider, such as direct regulation, taxes and emissions trading. Under these circumstances, attracting the attention of the world is a sectoral approach, which is to set benchmark efficiency for each sector, and to require companies around the world to strive to catch up with the market leaders. Even though it involves some difficulties, such as the setting of appropriate benchmarks, and financial and technology aids by developed countries would be necessary for developing countries to catch up, earnest discussions should be held concerning the sectoral approach, as this approach will directly promote technological innovation and deployment.

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