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The Analysis on Barriers of Low Carbon Technology Transfer

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Abstract

This study summarize the barriers of low carbon technology transfer. Based on analysis of the findings of the literature on technology transfer, this paper presents a summary of key areas for future action in order to facilitate the transfer of low carbon technology to developing countries.

Keywards: Climate change; Low-carbon technology transfer; Barrier

1. Introduction

There is growing awareness that a transition to a sustainable energy economy is one of the most important challenges which is faced by us in the 21 Century. One of the main drivers for this transition is climate change. The impact of climate change will be more serious than suggested by early predictions. The most important greenhouse gas is carbon dioxide and the most new carbon abatement technologies are being developed in industrialized countries. However, it is in developing countries where much of the potential to make significant reductions in emissions. Thus, the successful transfer and absorption of these low carbon technologies is critical to tackle climate change.

At Gleneagles in July 2005, the G8 highlighted the importance of strengthening technology cooperation to develop low carbon energy options. Many developing countries pressed for a new approach to international cooperation in the area of clean energy technologies. The transferring of low carbon technology to developing countries can assist developing countries in their efforts to reduce carbon emissions by adopting low carbon technologies. This adoption process has two aspects: the development of new innovative capacity in low carbon technologies and the diffusion of these

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technologies in the market. Everyone can benefit from this adoption process, both developed countries and developing countries.

The central focus of this paper is on understanding how developed and developing countries might best cooperate in order to facilitate the transfer of low carbon technologies. In order to understand what barriers exist to low carbon technology transfer, it is necessary to outline the centrality of knowledge transfer.

2. Theoretical Analysis on technology transfer

Schnepp et al. define technology transfer as "a process by which expertise or knowledge related to some aspect of technology is passed from one user to another for the purpose of economic gain."[1] In the case of the transfer of low carbon technology, the economic benefits are associated with the mitigation of the future costs associated with climate change.[2]

There are two kinds of technology transfer, vertical technology transfer—the transfer of technologies from the R&D Stage through to commercialization; horizontal technology transfer—the transfer from one geographical location to another. In reality, this distinction between horizontal and vertical technological transfer is unlikely to be so distinct. In case of low carbon technology transfer, the transfer of technology from one country to the next represents horizontal transfer. But this transfer may also involve a degree of vertical transfer, because the transferred low carbon technologies might be pre-commercial technologies and undergo development towards commercialization within the new country.

The latest literature showed that technological transfer is not just a process of capital equipment supply from on firm to another. Comprehensive technology transfer also includes the transfer of sills and know-how for operating and maintaining technology hardware, and knowledge for understanding this technology so that further independent innovation is possible by recipient firms.[3] As showed in Figure 1, international technology transfer can be broken down into two stages. The first stage is the supply of technology to recipient countries; the second stage involves building on new capacity within the recipient country.

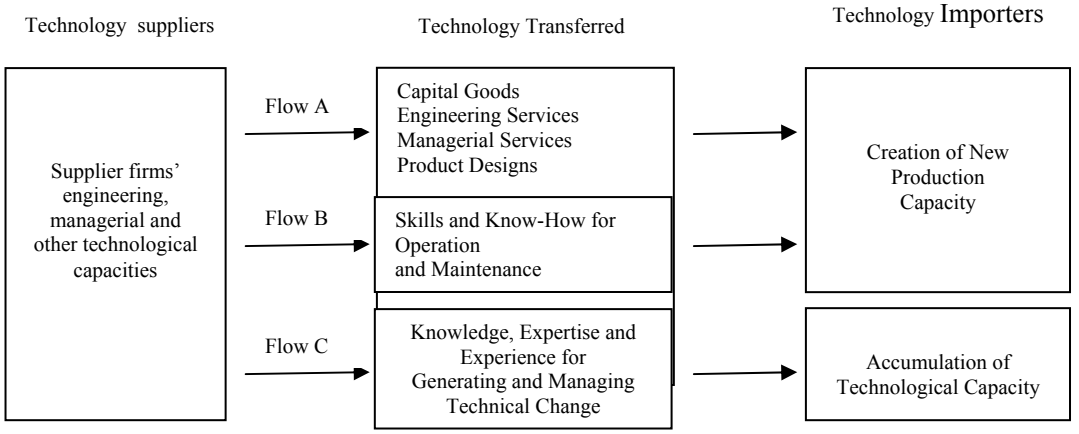

Fig. 1. The technological content of international technology transfer

There are two different schools of thought concerning how technology transfer translates into new technological capacity within recipient countries. Neo-classical accumulation theories, traditionally assumed that the learning that underpins capacity building within developing countries automatically followed capital investments. However, assimilation theories, stress that learning is a key factor in

making capital investment successful. Knowledge transfer therefore becomes central to ensuring that technology supply leads to successful capacity building in recipient countries.

3. Barriers to Low Carbon Technology Transfer

A number of analyses of barrier to technology transfer have been produced in the past. We will discuss barriers to technology framework within the context of technology transfer process and technology transfer mechanisms. The barriers can be summarized as follows:

3.1 Transfer of capital goods and equipment (Flow A)

3.1.1 Financial barriers

Barriers of capital goods and equipment are likely to be financial. The import countries might be lack of funds to aid technology transfer, or/and don't have effective international mechanisms for finance. In many cases, there is increased expense associated with implementing new large-scale industrial technologies which can achieve incremental improvements. If the importers don't have the access to finance enough fund to cover the expenditure, they might prefer to chose the low carbon technology which is not most-advanced but at an acceptable price. One example would be the expense of installing new supercritical boilers within coal fired power plants as opposed to increasing the efficiency of existing plant by improving its operation.[4]

3.1.2 political barriers

Political barriers often include the potential for political instability in developing countries or perceived weaknesses in enforcing policy. This is of particular importance for low carbon technologies, because the development of low carbon technologies is often incentivised by stong environmental policy. There are also political barriers to the transfer of specific technologies, such as one of the most important low carbon technology -- nuclear technology, where this is perceived as posing a threat to international security.

3.2 Transfer of sills and know-how (Flow B)

Developing countries can benefit from technology transfer, mainly because the recipient countries grasp the skills and know-how for operating the technology and then be capable of developing new production capacity. To large extend, The strategy of technology supplier determined how much know-how are transferred. For example, transferred know-how and skills are more easier found in FDI, comparing with technology export only. For example, a lack of sufficient training on skills and know-how has often been observed at power generation plants where technology transferred as turnkey project. This has resulted in many power plants in developing countries being operated at sub-optimal capacity. All in all, If the developing countries can not be enable to optimally operate the technology, recipient countries are not incentive to import the technology.

3.3 Transfer of knowledge and expertise (Flow C)

Generally, the development of new technological capacity in developing countries are depending on the transfer of Flow C, which is necessary for generating and managing innovation and technological technological change in recipient countries. These kind of new technological capacity assure the recipient countries can absorb the exist low carbon technology and develop it further.[5]

How technology transfer translates into new technological capacity within recipient countries? Different people have different idea. More recently, however assimilation theories of technology transfer have tended to gain greater support from the empirical evidence.[6] Simply transferring of capital goods does not guarantee improvement in technological capacity in recipient countries. From developing countries' point of view, incentives to cooperate with developed are to develop the capacity of production and technology thought introducing new low carbon technology. They aim to be less depend on developed countries in technology now and be exporter of technology someday in future.[7]

In terms of low carbon technology transfer, if the developing countries have greater absorptive capacity, the countries have more incentives to induce the new low carbon technology. While, if absorptive capacity within developing countries firms is strengthened, the technology supplier might reluctance to engage in deeper knowledge transfer and prefer to export capital equipment only. [8]

3.4 Demand for technology transfer

The above discussion of barriers tends to assume a situation where demand exists for particular technologies but barriers exist to their transfer. There are some indirect barriers which reduce the demand for low carbon technology transfer.

The developing countries might have a preference for conventional technologies because pre-commercial technologies always connect with high risk, new technologies might relate either to the high cost of acquiring or the high cost of operating them. Also, the developed countries and developing countries have different views on what is the acceptable and appropriate new technology in many cases. Last, sometimes the potential technology importer has poor knowledge of available technologies, because some technology suppliers reluct to share information and want to maintain international competitiveness.

3.5 Status of technology development

In fact, many low carbon technologies are still at pre-commercial and supported commercial stages. So government intervention might have an important role to play in encouraging their adoption. Three key stages of technology development are classified as follows:

- Pre-commercial technologies that are not commercial in either developed or developing countries and are still undergoing significant demostration and R&D, e.g. LED lighting.
- Supported commercial technologies that are starting to be deployed in supported markets, but that are making slower progress in developing countries, e.g. hybrid vehicles.
- Commercial but slow diffusion technologies that are in common commercial usage in developed countries, but that have a slow rate of diffusion in developing countries, e.g. techniques for improving power station combustion efficiency.

We have to be aware of the fact that the barriers to the transfer of low carbon technologies are likely to vary according to the stage of development of these technologies. The barriers of pre-commercial and supported commercial low carbon technologies are different from commercial ones, the barriers of which are focus on horizontal, from one geographical location to another.

The pre-commercial and supported commercial status of many low carbon technologies means that many of these technologies have not been widely adopted in developed countries. The barriers faced to the transfer of these technologies to developing countries are similar to the barriers to their adoption within developed countries. The barriers of these technology transfer have a vertical component as well as a horizontal components.

Pre-commercial and supported commercial technologies are more likely to be subject to higher costs of initial investment than existing commercial technologies. Often, the pre-commercial and supported statues of such technologies may also mean that the costs associated with their adoption are subject to a high degree of uncertainty. For example, private investors are unlikely to invest in large-scale production

of hydrogen fuel cells, although they know it is clean technology. The reason is they are not sure about the sufficient demand in market for hydrogen fuel cells. Unless the market price are reasonable, say low enough, the demand of hydrogen fuel cells will increase. However, it is impossible to achieve target of low cost without large-scale production. In this case, developed countries can establish the large-scale factories in developing countries, only if the specific developing country has a strong intelligent property rights. Thus developed countries achieve the economic scale and developing countries develop the technology capacity, win-win situation reached.

3.6 Government intervention in technology transfer

One of the reasons that many low carbon technologies are uneconomic under current situations is that the environmental and social cost for carbon emissions is not priced. Lack of a carbon price presents an important barrier to low carbon technologies' development and deployment. Many economic instruments such as taxes and tradable permits are often used to price carbon. The practice of European Union Emissions Trading Scheme (EU ETS) and Clean Development Mechanism (CDM) under the Kyoto Protocol showed that this kind of arrangement didn't have an explicit technology transfer remit, but it might facilitate technology transfer to other countries where emissions reduction projects involve technologies not currently available in host countries.

In addition to developing market frameworks and financial mechanisms that favour low carbon technologies, government often seek to exert more direct influence over technology transfer processes. There are some successful example of government-driven technology transfer, as well as failure ones.

Finally, when we noticed government intervention is likely to play a key role in facilitating low carbon technology transfer by developing a suitable policy, we still have to be in mind that government involvement usually designed to overcome barriers to low carbon technology transfer can also introduce new barriers to transfer.

3.7 Market Structure

In 2007, Barton first argued that the market structure of specific industry determined how many low carbon technology transferred. In some industries, there are dozens of suppliers of specific low carbon technology in world market. It is possible for developing to get the technology at a reasonable price, such as technologies in wind energy and solar energy industry. While integrated Gasification Combined Cycle (IGCC) is another story. There are only several suppliers in market. So they got the monopoly power to charge high price. Facing monopoly power, the barriers on low carbon technology are much more higher than other market.

3.8 Intellectual property rights (IPR)

IPR protection has become an increasingly important issue in international negotiations on a variety of topics, including low carbon technology transfer. The fact is when a company are considering transfer low carbon technology, it must assess the level of IPR in reception countries for sure. But the effect of IPR on low carbon technology transfer are still unclear. IPR do have positive and negative impacts on technology transfer. Stronger IPR reduce the scope for informal technology transfer via imitation, which was an important form of learning and technical change in developing countries. At the same time, stronger patents, trademarks and trade secrets will reduce the costs of achieving formal technology transfer and expand such flows.

Strong IPR on low carbon technology implies that the developing countries will spend more expenditure on imported technology. Because most all developing countries don't have enough fund to

support the development of low carbon technology, IPR became a important barrier on low carbon technology transfer.

4. Conclusion

Most new low carbon technologies are being developed in industrialised countries. However, much of the potential for these technologies to make significant reductions in carbon emissions is in developing countries where fissile fuel consumption is increasing rapidly. The transfer of low carbon technologies to developing countries is central to tackling climate change. This paper summarizes a number of key barriers of low carbon technology transfer and highlight the future action for governments in both developed and developing countries to facilitate low carbon technology transfer.

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