Intellectual property rights and low carbon technology transfer: conflicting discourses of diffusion and development

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Abstract
Intellectual property rights (IPRs) and the transfer of low carbon technologies to developing countries have been the focus of sustained disagreement between many developed and developing country parties to the United Nations Framework Convention on Climate Change (UNFCCC). We argue that this disagreement stems from two conflicting political discourses of economic *development* and low carbon technology *diffusion* which underpin developing and developed countries' respective motivations for becoming party to the Convention. We illustrate the policy implications of these conflicting political discourses by examining empirical evidence on IPRs and low carbon technology transfer and highlight how the two discourses are based on an incomplete understanding of the role of technological capacity in either economic development or technology diffusion. This has important implication for the success of a post-2012 climate agreement.

Introduction

Low carbon technology transfer to developing countries has a central role to play in mitigating[1] carbon emissions from future economic growth and is a key issue in the international climate negotiations under the United Nations Framework Convention on Climate Change (UNFCCC). The promise of access to new technologies is widely recognised as a central incentive for developing nations coming on board in the UNFCCC in 1992. Although it was nominally designed to facilitate low carbon technology transfer, the success of the Convention in achieving this (Feldman 1992) has been widely questioned with many developing nations left feeling frustrated at the lack of progress that has been made in achieving technology transfer in practice[2] (Kohr 2008). Negotiations on the issue have become increasingly fraught, with clean technology nearly falling off the agenda in Bali 2007 due to disagreements between the United States (US) and G77/China[3].

Despite the high profile of technology transfer within international negotiations, inadequate empirical evidence exists upon which to base policy. The different stages of development of low carbon technologies, from research and development (R&D) through to commercial diffusion, introduce new and unique barriers, opportunities and policy challenges which are not yet properly understood (Ockwell et al. 2008). These challenges are confounded by the need for urgent action if dangerous climate change is to be avoided (Stern 2006; IPCC 2007).

One issue in the area of low carbon technology transfer that has provoked particularly thorny debate between developed and developing countries, and which epitomises the lack of empirical evidence available to guide decision making, is the issue of intellectual property rights (IPRs). IPRs are legal rights over ideas, creative processes and products. They include copyrights, trademarks, and patents – where holders can prevent the use of these technologies; thus patents are likely the most important type of IPRs within this context (Harvey 2008, p. 5). There are essentially two sides to this debate. On one side commentators assert that low carbon technologies are public goods, contributing as they do to the mitigation of future carbon emissions, and that the IPRs to these technologies should therefore be bought up by an international fund and made freely available to developing countries, similar to agreements made over certain anti-retroviral drugs for treating HIV/AIDS. On the other side of the debate some argue that low carbon technology transfer will be better facilitated if developing countries tighten up their legal frameworks for IPR protection, and the enforcement thereof. [4]

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[1] Technology transfer also occurs in relation to adaptation technologies but the focus of this paper is on technologies for mitigation.

[2] It is important to note that a lack of effective technology transfer to the developing world (and particularly least developing countries) is not limited to low carbon technologies. See Foray 2008, cited in Oliva 2008, p. 3, which looks at technology transfer to least developed countries more broadly, within the context of the World Trade Organization (WTO).

[3] The Group of 77, established in 1964, as well as China, often referred to G77/China, is the name of the key bloc of developing nations within the UNFCCC process.

[4] In the UN climate negotiations in 2008, these polarities continued to surface as some developing countries including India and China asserted the need to address IP issues within the discussions on technology,

Many observers and parties to the IPR debate are pinning their hopes on further empirical analysis providing a basis for guiding new policy responses or for supporting the maintenance of the status quo. As emphasised by a delegate at a seminar on IPRs and low carbon technology at Chatham House (2007): "Proposed changes to the existing [IPR] system must include significant evidence that a clear and identifiable need exists and that the change is the most appropriate way of addressing the need." In this paper, however, we argue that the debate on IPRs in the context of low carbon technology transfer is symptomatic of a broader divide between parties to the international climate negotiations. We characterise these as two polar opposite, conflicting political discourses of technology development and technology diffusion. These conflicting discourses are based on different ideas of what technology transfer seeks to achieve and have significant implications for what policy measures are considered appropriate for encouraging technology transfer.

In this paper we demonstrate how these conflicting discourses imply that the IPR issue, and low carbon technology transfer more generally, are likely to continue to represent a sticking point in the international negotiations. In fact, as we highlight at the end of this paper, the conflicting discourses that underpin the political stalemate on low carbon technology transfer are both based on an incomplete appreciation of processes of technological capacity development and technology diffusion. A starting point for a post-2012 agreement must therefore begin with recognition of, and reflection on, the limitations of these discourses and substantive efforts to implement policy that will, in practice, achieve the dual aims of development and diffusion.

We begin by explaining in more detail the two sides to the IPR debate before expanding on the two conflicting discourses of development and diffusion that characterise the political debate on low carbon technology more generally. We then review the scant empirical evidence available to date on IPRs in relation to low carbon technology transfer to illustrate how the policy implications of this evidence can interpreted very differently by policy makers according to whether they adhere to the discourse of development or the discourse of diffusion. We end the paper with a brief discussion that demonstrates the shortcomings of both the development and diffusion discourses and outline a basis for reconciling the aims of both these political discourses under future climate agreements.

Two sides of the IPR debate

As mentioned above there are essentially two sides to the IPR debate in relation to low carbon technology transfer. Firstly, drawing on assumed parallels with the pharmaceutical industry and access to, for example, anti-retroviral drugs[5], some

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while some developed countries, such as the United States, espoused the view that IP was a catalyst and not a barrier for technology transfer (Oliva 2008, p. 4).

[5] It should be noted that significant differences exist between pharmaceuticals where often a single patent determines its use and low carbon technologies where several patents often exist in relation to different components and technological developments (Harvey 2008, p. 9). This has important implications for the proportion of IPR related costs across these different industries.

observers claim that a lack of access to IPRs for new low carbon technologies is a key barrier to their transfer and deployment in developing countries. This argument sees low carbon technologies as public goods (due to their contributing to avoiding future carbon emissions) that should be freely available. Proponents of this argument highlight how IPRs can prohibit access to new technologies by, for example, enabling firms that own patented technologies to keep prices prohibitively high. They also observe how IPRs can reduce the scope for imitation which, in countries such as South Korea and Japan, and even the US, has been a key source of learning and technological change (UNCTAD-ICTSD 2003, p.85).

Such arguments have played out in the negotiations under the auspices of the UNFCCC where calls have been made for multilateral funds to be created to buy up IPRs for low carbon technologies and make them freely available to developing countries (see, for example, Third World Network 2008). Critics of such a fund, however, highlight the fact that access to a patent is unlikely to prove sufficient to enable access to that technology. There is often a lot of undisclosed tacit knowledge associated with patents that is essential to understanding and working with new technologies (UNCTAD-ICTSD 2003, p.86). Nevertheless, patent ownership is strongly skewed towards the North (IPCC 2000, p.98) suggesting that, especially within the context of stronger IPR regulations under TRIPS,[6] it may well become increasingly difficult for developing countries to access clean technologies under favourable terms.

The opposite end of the IPR debate revolves around a claim that a lack of IPR law or the enforcement thereof in developing countries is the main barrier to low carbon technology transfer. Further, IPRs are asserted to be central to innovation and encouraging the diffusion of technologies as patents force inventors to disclose their technology publicly (Harvey 2008, p. 6). The argument is made that trans-national companies (TNCs) are unlikely to deploy cutting edge technologies that they have spent significant resources developing in countries where they cannot ensure adequate patent protection. IPRs are seen as a catalyst rather than a barrier to the creation and deployment of low carbon technologies, providing the incentive needed for businesses to invest in risky ventures, giving legal clarity and certainty, and stopping others from blocking the use of a technology by follow-on derivative inventions (Harvey 2008, p. 3).This argument is reflected in the TRIPS agreement, one of its stated rationales being that the protection and enforcement of IPRs will contribute to both increased FDI and the transfer and dissemination of technology (UNCTAD-ICTSD 2003, p.85).

Others see this as simple protectionism on behalf of powerful western economies. The US manufacturing sector in 1995, for example, had in excess of a $20 billion trade surplus on licence fees and royalties on industrial processes sold abroad (UNCTAD-ICTSD 2003, p.37), which could be seen as a strong political incentive for pushing for

[6] TRIPS, the agreement on Trade Related Aspects of Intellectual Property Rights, aims to create uniform IPR protection across developed and developing countries. It is administered by the WTO and has brought IPRs into international trade negotiations for the first time. Developing countries were given longer to conform to the agreement than developed countries and least developed countries have until 2016 to conform.

stricter patent enforcement in developing countries, particularly within rapidly expanding markets such as China and India. This kind of surplus is not, however, reflected in all developed countries. The UK had a small surplus in 1995 ($1.71 billion), whereas Japan and Germany both had deficits ($3.35 billion and $2.66 billion respectively). These were higher than those in many developing nations e.g. India $68 million and Brazil $497 million (Patel and Pavitt 1995 in UNCTAD-ICTSD 2003, p.37). This is, however, likely due to the fact that countries such as Germany and Japan rely more on exports to exploit their technological advantage, whereas the US and UK opt more for foreign direct investment (FDI) which involves more royalty payments. This raises important questions with regard to the overall benefits to developing countries of such trade relationships in the context of their access to, and technological capacity to work with, low carbon technologies – a point central to the development discourse described below.

It is our argument in this paper that political support for ideas such as creating a multilateral acquisition fund to buy up IPRs for low carbon technologies, or, at the opposite polarity, support for tightening IPR regimes *a la* TRIPS, or neither, is dependent on which of the two conflicting political discourses is being subscribed to. In the next section we describe the nature of these two discourses in more detail.

Conflicting discourses of diffusion and development

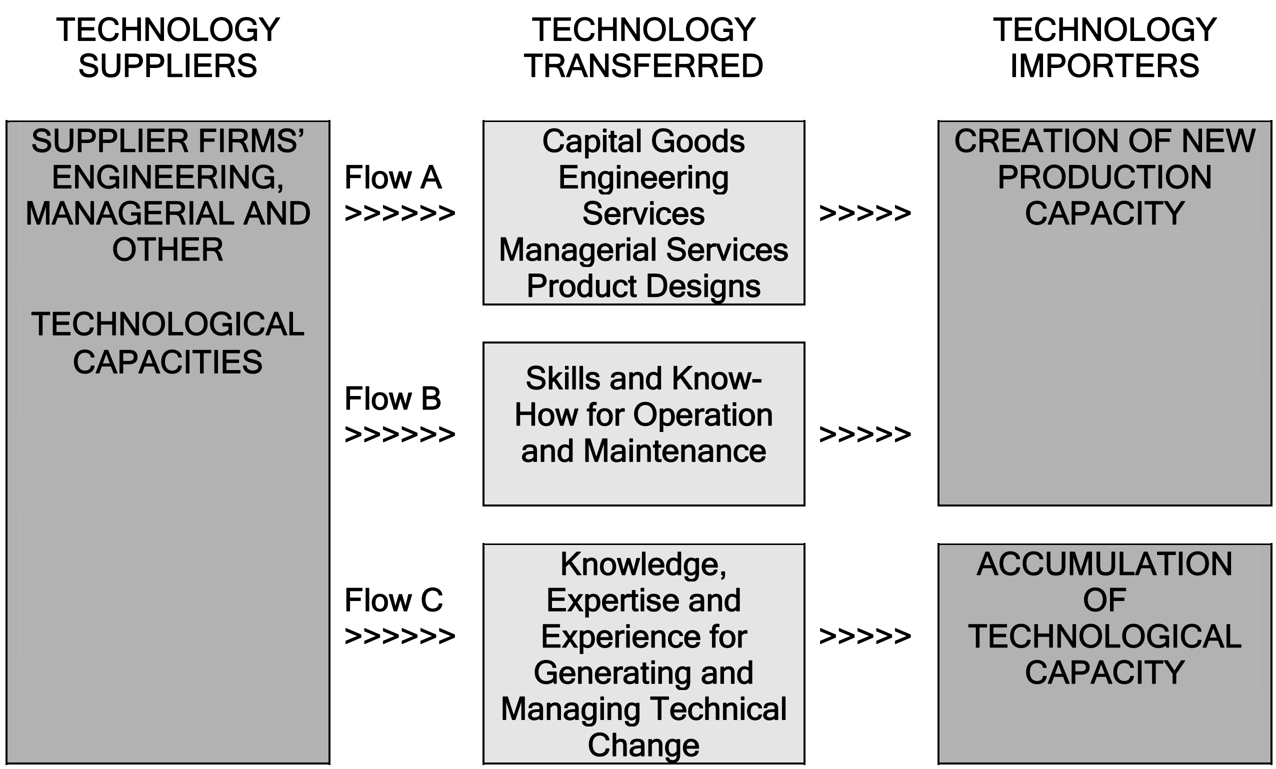
The conflicting political discourses (Ockwell and Rydin 2006) of diffusion and development that characterise the policy debate on low carbon technology transfer have their roots in a historical north-south divide concerning the motivation for involvement in an international climate agreement (or, for that matter, environmental agreements *per se*). For developed nations the key motivating factor was, *a la* Stern (2006), recognition of a need for global action to mitigate carbon emissions so as to avoid the future costs of climate change. Developing countries, on the other hand, have a very different perspective. They are acutely aware of the fact that the majority of the current stock of atmospheric greenhouse gases, and hence the majority of associated warming over the next few decades, is a result of the economic activity of developed nations over the last two hundred years. On this basis they feel fully justified in pursuing a primary goal of economic development and poverty alleviation. Any involvement in an international climate agreement is tempered by the caveat that emissions reductions should not be pursued at the expense of such development.

To some extent this north-south tension was resolved through the emergence of the discourse of sustainable development in the 1980s following the publication of the Bruntland report (World Commission on Environment and Development 1987). This report also highlighted the fact that environmental problems in developing countries were at least in part a result of economic and technological deficiencies in the south. Recognition of a north-south economic/technological divide has, in the context of the UNFCCC, played out in the idea of common but differentiated responsibilities where developing nations are not subject to binding emissions targets. But not putting the brakes on economic development was not in itself a justification for developing country involvement in the UNFCCC. The main carrot came via the idea of “Ativities Implemented Jointly”, including Joint Implementation (JI) (Bush and Harvey 1997; Kim

2001)) and the Clean Development Mechanism (CDM), and in particular the idea that developed countries would meet some of their emissions through the transfer of new, clean technologies to developing countries (Gupta 1997; Grubb et al. 2001; Neumayer 2002; Ravindranath and Sathaye 2002, p.253).

A north-south gap historically exists in terms of technology ownership (Missbach 1999) and technological capacity, with developed countries having a clear technological advantage. Developing country governments understand that increased access to technology is one of the pre-requisites of economic growth, self reliant development, and poverty alleviation. By becoming party to the UNFCCC, developing countries therefore saw an opportunity to access new, low carbon technology and thus contribute to reducing their technological dependency on the north (Roberts and Parks 2007) and become technology producers and innovators in their own right. They recognise the role that new technologies and technological change within existing industries can play in improving competitive advantage through increased factor productivity and/or the development of new, competitive products (Murphy et al. 2004) and broadening the industrial base of a country via the establishment of new industry sectors with associated employment benefits, profits and public income through taxes (Lall 1998; Gereffi 2001). Access to new technology not only offers the possibility of moving up the value chain, it also provides opportunities to diversify into new products similar to the ones originally imported (Bell 1997).

Figure 1. The technological content of international technology transfer



Source: Based on Bell (1990)

Developing countries' understanding of the role that technology transfer can play in their economic development has firm roots in the academic literature on the subject. Bell (1990) offers a useful starting point for understanding the various issues and processes that are at play here. 'Technology' first needs to be understood as both 'hardware' (physical equipment) and 'software' (knowledge and processes). Bell's model illustrates how three qualitatively different flows can be identified within the process of transferring technology from a technology owner or supplier to a technology recipient (see figure 1). Flow A comprises the capital goods and services needed to create the physical facilities of a new production system. Flow B refers to the skills and know-how needed to operate and maintain the newly installed production facility. Some of these skills might already exist in the host country, but usually, as Bell highlights, if transfer projects involve elements of flow A, at least some elements of the whole transfer process fall into category B. Flow C refers to the skills and knowledge necessary to generate technical change.

Although, as Bell points out, there is no sharp distinction between C- and B-type flows, C-type flows are significantly different from, and additional to, the knowledge needed to operate a production facility. While flows A and B lead to the creation of new production capacities in the recipient country, C-type flows enable the additional benefit of augmenting technological capacity. This includes the capacity to adapt the technology to local, changing needs, to replicate it, enhance it and eventually create a new product. The development of new technological capacity is thus central to a firm, industry or country's ability to improve their competitive advantage and expand existing industries and the overall industrial base (Criscuolo and Narula 2008). Hence the contribution of low carbon technology transfer to developing new technological capacity is a central concern for developing countries within the context of their economic development priority.

But while developing countries see low carbon technology transfer as a means of strengthening their technological capacity and contributing to their economic *development*, developed nations approach the issue from a very different perspective. As highlighted above, developed nations' motivation for involvement in the UNFCCC is first and foremost the mitigation of greenhouse gas emissions. From this perspective, the primary objective of transferring low carbon technologies to developing countries is to achieve rapid and widespread *diffusion* of these technologies so as to reduce the emissions associated with future economic development in these countries. The impact of this diffusion on technological capacity and economic development is not a priority. In fact, despite the political rhetoric on poverty alleviation, developed countries, and certainly firms in those countries at the forefront of advanced low carbon technologies, have a vested interest in maintaining a level of completive advantage over developing countries.

Anyone (including several of the authors of this paper) who has been involved with the climate negotiations will testify to the fact that this kind of political economy consideration weighs heavy in the background of the negotiating positions of several powerful developed nations. The notion of diffusion under this discourse is more about diffusion at a superficial level. For example, it is possible to imagine how a technology such as solar PV cells could be put into widespread use, hence delivering emissions reductions, by supplying it 100 per cent via sales from developed to developing countries.[7] This might be sufficient in environmental terms but would not fulfil developing nation's interest in technological capacity development by, for example, 'learning' how to manufacture solar cells with the same level of efficiency as imported cells, or, for example, how to slice silicon.

This idea of differentiated efficiency between imported and domestically produced low carbon technologies in developing countries represents another important divide between the development and diffusion discourses. As discussed further below in relation to IPRs, the diffusion discourse would see the widespread use of slightly less efficient, domestically produced technologies as a desirable outcome of technology transfer activities that have contributed to the development of domestic manufacturing capacity. From the perspective of the development discourse, on the other hand, such an outcome would be sub-optimal. The desire instead would be to develop sufficient domestic technological capacity so as to be able to manufacture cutting edge, internationally competitive technologies.

The divide between the discourses of development and diffusion is central to the lack of agreement between developed and developing countries within the negotiations on low carbon technology transfer under the UNFCCC. As Forsyth (1999, p.60) puts it: "Technology transfer has become a symbol of the long-standing resentments between North and South...". In the next two sections we demonstrate how this plays out in the debate on how policy ought to deal with the issue of IPRs in relation to low carbon technology transfer. We begin by reviewing the empirical evidence available to date on IPRs and low carbon technology transfer before examining this evidence through the lenses of the two opposing discourses.

IPRs and low carbon technology transfer: empirical evidence to date

Empirical evidence available to date on IPRs in the context of low carbon technology transfer is extremely limited. The authors are aware of six main attempts to engage with the issue. The first, by Barton (2007), tackles it via a case study based review of the markets for three renewable technologies (solar PV, wind and biofuels). The second, by Lewis (2007), presents an in depth analysis of the wind power industry in China and India and is drawn on extensively in Barton's analysis. In the third, Harvey (2008) addresses this issue by examining IPRs more generally among developing countries, homing in on the potential role of China and international institutions, such as the World Trade Organization (WTO). The International Centre for Trade and Sustainable Development (ICTSD) has carried out two studies that examine the role of intellectual property for climate technologies. The first document (ICTSD 2008, Ch.4), entitled "Climate Change and Trade on the Road to Copenhagen" dedicates a chapter to the potential role of IPRs. The second (Oliva 2008), "Climate Change, Technology Transfer and Intellectual Property Rights", provides an overview of the issues, drawing from

[7] As long as the basic cost barrier is overcome – which is made more significant if developed country firms are selling to developing country customers

evidence from studies of technology (not necessarily low carbon) transfer to developing countries and discusses how IP might be dealt with under the UNFCCC process.

The final study is Ockwell et al. (2006; 2008) which, on a case study basis, was able to make some tentative suggestions of IPR relevant insights, but did not have enough of an explicit IPR focus to be able to explore these in any depth.[8] The case studies studied by Ockwell et al. were integrated gasification combined cycle (IGCC) for power generation, LED lighting, hybrid vehicles, biomass generation and improving the combustion efficiency of existing power stations.

Access to low carbon technologies

The above studies found that developing country firms had access to all the technologies examined. IGCC and hybrid vehicles in India were, however, still at the R&D stage and seemed to be driven by indigenous R&D rather than access to internationally owned patented, or previously patented, technologies. Indian LED manufacturers were also not yet working with white LED lighting, which are at the cutting edge of LED technology, although their Chinese counterparts are.

Harvey's study also affirms that developing countries generally do have access to low carbon technologies. He asserts that companies often do not bother filing for patents in Least Developed Countries (LDCs), as they focus their patenting efforts on more substantial markets. He also argues that companies are willing to sell products at a lower price in developing countries if there is no concern about leakage, or that these lower cost products ending up back in their main markets. Thus, many of those interested in using low carbon technologies in developing counties can do so (Harvey 2008, p. 9). He suggests a series of options in those instances where IPRs may be hindering access to low carbon technologies in LDCs. These options include licensing at zero cost or on favourable terms and / or government subsidizing the cost of using a patented technology.

The first ICTSD study indicates that there has been no comprehensive study done to date on the potential impact of IPRs on climate technologies. It also states that, in addition Barton's study, two studies done by the European Patent Office (EPO), on biofuels and wind respectively, noted that patents have been increasing in both areas (ICTSD 2008, p. 36). The ICTSD study done by Oliva asserts that there is no definitive answer regarding whether IPRs hinder or assist the transfer of climate technologies. Like Harvey, Oliva proposes the use of existing tools within TRIPS to assist technology transfer in the climate regime in cases where IPRs may have a negative effect, but these suggestions – such as exemptions to patentability, patent rights, or compulsory licensing – are different than those proposed by Harvey (2008).

Importantly, developing country firms were generally not observed to have access to the most cutting edge technologies within the sectors examined. One exception is a Chinese firm, Sichuan FAW, that has gained access to Toyota's cutting edge hybrid vehicle technology via a joint venture arrangement. The extent to which they have access to the

[8] A second phase of work by these researchers that focuses more explicitly on the issue of IPRs and low carbon technology transfer is now underway, see http://www.sussex.ac.uk/sussexenergygroup/1-2-9.html

underlying knowledge is, however, questionable as Toyota currently manufactures its Hybrid Synergydrive drivetrains in Japan and ships them to China for assembly (Ockwell et al. 2006; Ockwell et al. 2008).

Barton and Lewis' analysis demonstrates how access to wind technologies in India and China has been facilitated via the acquisition of licenses from developed country firms and, in the case of India, also by strategic acquisition of developed country firms. In the case of solar PV, China has pursued a strong policy of indigenous technology development, whereas India's access has principally been via a joint venture with BP Solar, suggesting future solar PV activity in India will be dependent on BP Solar's international market strategy. For biofuels, Barton notes significant indigenous ethanol industries in China, India, Pakistan, Japan, Thailand and Malaysia as well as the notable success of Brazil in this sector.

Barton (2007) makes an important contribution in his analysis by highlighting the role that industry structure plays in determining access to new technologies. He argues that, whilst at least two of the renewable technologies that he studies (wind and solar PV) have a moderately concentrated market, dominated by a limited number of large players, the industries are loosely structured enough to allow for new entrants, and future market opportunities in developing countries are likely to incentivise technology diffusion. Barton also highlights the relevance of the economics of access to these technologies. Because there is sufficient international competition in wind for example, getting a license is not prohibitively expensive for some developing country firms.

Access to the cutting edge

Despite the overall optimistic tone of Barton's analysis, it is notable that for all of the case studies he examines, uncertainty is expressed as to the likelihood of developing country firms gaining access to the most advanced technologies in these industries. Companies owning patents to new thin film solar PV technologies and new enzymes being developed for biofuel production may be hesitant to make these available to developing country firms, and the industries are concentrated enough that developed country firms could price developing country firms out of the market. Similar issues in terms of access to the know how behind cutting edge technologies were also raised by Indian firms in relation to IGCC and LED lighting in the Ockwell et al. study. Kohr (2008) also suggests – using experiences from the Montreal Protocol – that access to cutting edge technologies by developing countries is limited.

To some extent Suzlon, India's most successful wind technology manufacturer with the fifth biggest share of the global market, has overcome these issues by buying majority shares in developed country firms in order to gain access to cutting edge technologies such as variable speed turbines. Having said this, Barton identifies wind as the riskiest area in terms of access to future cutting edge technologies and markets for these. He cites the case of the US where GE has successfully used litigation over patent infringement to block foreign access to the market.

This point is reinforced by Lewis who explains how Suzlon and China's leading wind technology manufacturer, Goldwind, acquired access to wind technology by licence purchases from second tier developed country firms. This, she argues, was due to the disincentive for leading companies to license to potential developing country competitors; a concern accentuated by the cheaper labour and materials available in developing countries. The only companies willing to sell licenses to use their technologies are therefore smaller companies with less to lose in terms of competition and more to gain in license fees. Lewis notes, however, that this does not necessarily imply technological inferiority compared to larger companies, but the fact that the technology has been used less implies less operational experience and hence less opportunity to perfect and prove the technologies.

Another issue for developing country firms highlighted by Barton is that, even where they are not working at the cutting edge, access to finance for new technologies could be an issue. Venture capital funds tend to favour new start ups with strong proprietary positions with regard to patented new technologies.

Policy implications: looking through the lenses of development and diffusion

The analysis above suggests two things. Firstly, IPRs do not seem to prohibit access by developing country firms to the low carbon technologies that the studies examined. This is particularly the case in rapidly developing countries such as India and China. Secondly, although IPRs might not prohibit access to these technologies, they do seem to play a part in prohibiting access to variants of these technologies at the cutting edge. In this section we examine the policy implications of these two observations through the lens of the two alternative discourses of development and diffusion outlined above.

From the perspective of the diffusion discourse, the fact that IPRs do not seem to be prohibitive to developing country firms accessing these low carbon technologies suggests that no specific IPR-oriented policy intervention is needed. Current market arrangements in relation to IPRs seem adequate to allow the diffusion of these technologies. As Lewis (p.22) puts it, “It took China and India less than 10 years to go from having companies with no wind turbine manufacturing experience to companies capable of manufacturing complete wind turbine systems, with almost all components produced locally. This was done within the constraints of national and international intellectual property law, and primarily through the acquisition of technology licenses or via the purchasing of smaller wind technology companies.” At the same time, it does call into question the necessity of the TRIPS approach of tightening up IPR regimes in developing countries. If international firms are already making clean technologies available under current IPR arrangements then diffusion is being achieved under the status quo.

There does, however, seem to be some variability in terms of the level of diffusion of the different technologies that have been studied. Wind, for example, seems to be a particular success story, especially in China and India. In the case of other technologies such as IGCC and hybrid vehicles it remains to be seen how well these technologies might diffuse through developing country, or for that matter developed country, economies. Without further empirical work in these and other technologies it is impossible to say whether IPRs form a barrier for low carbon technologies across the board. This is especially problematic as the studies reviewed above are sectorally limited mostly to power generation technologies (the exception being hybrid vehicles and LED lighting). It is reasonable to assume that other types of technology, such as transmission and end-use technologies might encounter different issues due to different market structures, different recipient country capacities, and so on. Nevertheless, the evidence reviewed above does suggest that IPRs are unlikely to be the only barrier to diffusion. Other issues, such as capacity of recipient firms to work with such technologies (Ockwell et al. 2006; Ockwell et al. 2008), often referred to as their absorptive capacity (a concept we cover in more detail below), or cost of new technologies (Lewis 2007), will play an equally important role in facilitating access.

As well as simply providing access to low carbon technologies, the diffusion discourse is also concerned with making sure these technologies diffuse throughout developing economies and that this diffusion occurs as rapidly as possible in order to respond to the urgency of climate change. From this perspective, then, policy interventions to encourage wide and rapid diffusion may be seen as necessary, but on the basis of the evidence reviewed above, IPRs are unlikely to be a focal point of such interventions. The main concern here is not with providing access to the cutting edge of these technologies. Rather it is to ensure that technologies with lower carbon emissions than older technologies are adopted so as to achieve maximum possible emissions reductions as rapidly as possible.

If, on the other hand, we move to the opposite polarity and look through the lens of the development discourse, then some important questions arise as to the adequacy of current market arrangements for dealing with IPRs. As highlighted above, the development discourse focuses on strengthening technological capacity within developing economies and a central plank of this relies on access to the knowledge that underpins cutting-edge technological developments, and exposure to the tacit knowledge often integral to developing the absorptive capacity necessary to work with emerging technologies. This raises concerns as to the extent to which proprietary ownership of IPRs might reduce developing country firms' access to the knowledge necessary for sustained, low carbon technological capacity building. This is not the same as arguing that access to IPRs per se will facilitate such capacity building. Rather, it is to argue that access to IPRs may play an important role in enabling developing country firms to understand and work with/imitate the knowledge that underlies new low carbon technologies. This is a particularly relevant concern in the context of strengthened IPR regimes under the TRIPS agreement which could limit the scope for developing countries to develop capacity through processes of innovation based on imitation. In the past, this strategy has been a central part of 'catching up strategies' for some developing country industries and firms. For example, Hyundai used this strategic approach to accessing knowledge (Kim 1998).

This issue is recognised by Lewis who highlights that countries are likely to pursue different strategies for obtaining low carbon technologies depending on the country's level of development. If the desire is to access advanced foreign technology without assimilating that technology into the local manufacturing base, IPR issues are likely to be less substantial as foreign companies can continue to sell that technology without the risk of local competition. If, however, the desire on behalf of the developing country is to assimilate new technologies and hence increase technological capacity, then developed country firms are more likely to use IPRs to prohibit access. Tebar Less and McMillan (2005, p.30) also note that strong IPRs provide incentives for companies mainly from industrialized countries, and so more research and analysis is needed to determine the benefits of strong IPRs to developing countries.

Barton (2007) seems to recognise a similar concern in his conclusions. In relation to the development of cutting edge technologies, Barton highlights a potential future need for developed country governments to avoid the levels of national favouritism for patents developed by public funding that have traditionally characterised the development of renewable technologies. He draws parallels with humanitarian licenses that have been granted in relation to agricultural and pharmaceutical technologies in the past. Barton also stresses the need to consider the subsidisation of research and development activities in developing countries. In a paper on the global scientific and technological commons, Barton (2008) goes even further to argue that it would be globally beneficial to establish a WTO style international treaty that attempted to remove barriers to the access of scientific and technological knowledge.

Shortcomings of the political discourses

The previous section demonstrates how the conflicting political discourses of diffusion and development can lead to conflicting policy positions in relation to IPRs. However, both these political discourses are based on an incomplete understanding of the processes that contribute to achieving technological capacity development and technology diffusion. The development discourse fails to recognise that there are a wide range of other processes that contribute to technological capacity development, above and beyond simple access to Bell's Flow C (the knowledge that underlies a new technology). In order for this knowledge to contribute to technological capacity, recipient firms first need to possess certain competences that will enable them to work with particular technologies (Hammond and Stapleton 2001). Or, in other words, they need to possess sufficient absorptive capacity to work with the technology in question. This is influenced by a wide range of factors, such as tacit knowledge, the internal organisation of the firm, interactions via inter-firm linkages, supply chains and networks, past learning efforts, investments in human capital and 'learning by doing', market structure and competitive pressure, government interventions to correct the failure of markets for knowledge (education, R&D training), government led institutional arrangements to facilitate innovation (R&D labs, technology intermediaries), and finally access to finance (Bell and Pavitt 1993). Without any of this, providing access to the IPRs for a new, low carbon technology would be a bit like giving a plumber access to the blueprints for a fighter plane – it is highly unlikely that the plumber would be able to successfully build the plane.

Similarly, while the development discourse ignores these additional aspects of technological capacity building, the diffusion discourse also ignores the vital role that technological change plays in achieving diffusion. The diffusion discourse implies that learning to use or apply a technology is a sufficient condition for its diffusion. But complex technologies do not diffuse in a new environment unless they are adapted to local conditions. Going further than this, diffusion may also involve the ability to replicate a technology, enhance it and eventually create a new product (Bell and Pavitt 1993). The diffusion of complex technologies like more efficient coal power technology, for example, seems crucially to depend on a high level of technology transfer and related in depth knowledge flows (Orshita and Ortolano 2002, Watson 2002).

Thus, a level of assimilation of a technology at a level higher than just the operational level (acquisition of designs, equipment, operational know-how) is often a necessary condition for diffusion (Bell and Pavitt 1993; Mukoyama 2006). Replicative assimilation (acquiring skills to replicate technology), adaptive assimilation (acquiring or developing skills for adaptation/ incremental improvement), and innovative assimilation (developing and acquiring capabilities for substantial development) all play an important role in ensuring the diffusion of a technology throughout an economy (Bell 1997). On this basis it becomes clear that the development of technological capacity in developing countries can play an equally important role in ensuring technology diffusion as it does in ensuring that technology transfer contributes to the economic development of recipient countries.

On the face of it, the weaknesses of the two political discourses outlined above suggest that they may, in fact, have more in common than their political proponents understand. Technological capacity development is central to technology diffusion, particularly in the long term, thus contributing to the goals of both discourses. And access to IPRs in isolation from other key factors, such as tacit knowledge and national networks of innovation, is unlikely to result in technological capacity development, thus lending some support to those commentators who refute the value of funds for buying up IPRs for low carbon technologies. Nevertheless, these commonalities are based on an in-depth understanding of complex processes that are difficult to study and do not provide easy, one-policy-fits-all solutions (Ockwell et al. 2008), which are ultimately what politicians look for. More than that, this promise of commonalities ignores the overriding political-economy concerns outlined above. These concerns translate into countries' negotiating positions being heavily influenced by considerations regarding the interests of national firms and industries and the influence of technology transfer on a nation's relative competitive advantage.

Conclusion

The two conflicting discourses of development and diffusion described in this paper go to the very heart of the negotiating positions of different parties to the UNFCCC. By looking in detail at the scant evidence available on IPRs and low carbon technology transfer it is clear to see how looking through the lenses of these different, polar opposite discourses can imply very different policy options. From the perspective of the diffusion discourse, the evidence implies that little policy action is required in the area of IPRs. The development discourse, on the other hand, implies a very different take on things. From this perspective, the fact that proprietary IPR for low carbon technologies seems to have prevented access to the cutting edge is of central concern if sustained low carbon technological development is to be achieved.

The IPR debate is perhaps the thorniest issue within the current international negotiations on low carbon technology transfer and represents a central dividing point between many developed and developing countries. But even without the IPR issue, low carbon technology transfer per se remains a serious sticking point in the negotiations, as demonstrated by the near failure of the technology negotiations during the Bali Conference of the Parties in 2007. By clarifying the opposing political discourses of development and diffusion this paper goes some way to demonstrating one of the central underlying reasons for such contested positions within the negotiations. We assert that a positive post-2012 agreement on technology transfer relies on both developed and developing countries taking time to reflect on their positioning at opposite ends of the development-diffusion polarity. They also need to directing efforts towards reconciling the fundamental differences that characterise their positions on the issue. To a large extent this might be helped by a better understanding of the full extent of the processes that underpin technological capacity development and the related role of this in facilitating technology diffusion. It will, however, also rely on some level of compromise by nations whose negotiating position reflects a broader self-interested concern with maintaining the historical economic divide between north and south. Without such a process of reflection and reconciliation it seems unlikely that the negotiations on low carbon technology transfer will transcend the frustratingly entrenched situation that has plagued the UNFCCC since its inception in 1992.

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