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■ outlook: insight

The role of international business in clean technology transfer and development

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While research has generated very useful insights, usually at the macro level, regarding the multifaceted nature of environmental innovation and regulation, the characteristics and drivers peculiar to international companies have remained underexposed in the policy-related literature on clean technology transfer and development. This article aims to help open the 'black box' of business, also as input for future policy making, by discussing aspects that influence corporate responses: sector-specific and company-specific peculiarities as well as those related to country contexts (both origin countries and host countries for companies). Most of the climate-related investments in 'developing' countries turn out to have been geared to a few emerging economies, generally involving established technologies with limited transfer, and a major role for developed-country utilities, particularly from Europe. Despite these limitations, there is a base with experience being built up, and a potential for extension to lesser-developed areas, but that requires market co-creation by joint business and governmental efforts. As viable business models are largely lacking, the article suggests three main modalities, ranging from fully commercial to primarily publicly funded, involving different types of actors and countries. Gearing policies more towards corporate realities and reaping the international momentum of sustainable energy might also further climate goals.

Keywords: climate change; corporate strategies; institutional contexts; multinationals; renewable energy; technology transfer

1. Introduction

The past two decades have seen many studies on (1) the importance of regulation for driving environmental innovation and (2) the specific types and design features of policy instruments that might be most suitable for helping break the 'carbon lock-in', as well as their technological, organizational, industrial, societal, and institutional sources (Johnstone, Haščić, & Popp, 2010; Kemp & Pontoglio, 2011; Kesidou & Demirel, 2011; Lanoie, Laurent-Lucchetti, Johnstone, & Ambec, 2011; Unruh, 2002). Although these have generated very useful insights, usually at the macro level, regarding the multifaceted nature of innovation as well as regulation, the characteristics and drivers peculiar to international companies

have remained underexposed in the policy-related literature on clean technology transfer and development. This article aims to help open the 'black box' of business, also to provide input for future policy making, by discussing aspects that influence corporate responses. These aspects are likely to differ between sectors and contexts (Kemp & Pontoglio, 2011; cf. Dechezleprêtre, Perkins, & Neumayer, 2012) as well as between types of companies (Kesidou & Demirel, 2011). Moreover, as shown in studies on the Clean Development Mechanism (CDM), the existence of a subsidiary of a multinational company in the target country is important for realizing technology transfer (Dechezleprêtre, Glachant, & Ménière, 2008, 2009). This suggests a need to better understand corporate decision making, as well as the location and direction of

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companies' international investments. This article will therefore, in subsequent sections, discuss sector-specific and company-specific peculiarities, as well as those related to country contexts (both origin countries and countries host to companies).

International companies usually operate in many different contexts, which are characterized by a multitude of policies, coupled with the high degree of regulatory uncertainty that has been inherent to climate change over the years. Many companies have called for more certainty and a stable policy framework in order for carbon markets to develop properly and for investments in clean technologies to be scaled up. In the absence of these conditions, money will be invested elsewhere, and companies may be discouraged from taking 'early action' and also refrain from innovation to address climate issues. While negative effects prevail, regulatory uncertainty may also benefit some companies if they recognize the opportunities of flux and move early to shape emerging rules and frameworks to their favour. This phenomenon has been explored in relation to the EU Emissions Trading Scheme (EU ETS) and for the CDM, particularly in the period 2006–2010, when uncertainty about rules, implementation, and interdependence with other regulations not only presented risks to companies, but also provided opportunities for some of them (Kolk & Mulder, 2011; Pinkse & Kolk, 2007). Benefits accrued in particular to 'low-impact' (i.e. not emissions-intensive) companies in trading and services, as well as utilities that developed (often opportunistic) entrepreneurial trading activities. It thus stimulated those that could manage and hedge risks and turn them into business

opportunities, rather than (eco)innovation and (clean) technology development.

2. Sector-based and company-specific aspects

This leads us to the first aspect relevant to a consideration of the potential role of business: sector-based types of activity. A basic distinction has been made between three different categories of companies (shown in Table 1) related to the degree to which they are affected by climate change (policy) and energy issues (Kolk & Mulder, 2011; Kolk & Pinkse, 2012). Most relevant in terms of technology transfer is the first category: companies that see their core activities being directly threatened. This includes high-salience industries such as oil and gas, automobiles, and utilities, as climate policy threatens their fossil fuel-based business models. However, the development of new key capabilities in a lower-carbon direction may potentially turn into a driver for future profitability and growth, particularly if companies are early movers. Other sectors in this category, e.g. agriculture and food processing, are strongly affected by the physical impacts of climate change because they depend on raw materials. The second category contains those companies that specialize in goods or services that can help to mitigate climate change impacts, or to anticipate, influence, or respond to climate policy developments. In addition to specialized carbon trading/offsetting and renewable-energy companies, banks, brokers, exchanges, consultants, auditors, and legal services providers also fall into

TABLE 1 Relevance of climate change for different categories of companies

Category of companies	Impact of climate change issue
High-salience sectors	Strongly affected due to their energy intensity and/or dependence Early change in business models might be a source of competitive advantage
Companies specialized in climate-relevant goods and services	Can profit by helping other companies to mitigate their climate change impacts or to anticipate, influence, or respond to climate policy
Remaining companies with low-emission activities	No main source of profitability/growth, but may gain legitimacy from acting visibly Can deal with the issue via external markets

Sources: Adapted from Kolk and Mulder (2011) and Kolk and Pinkse (2012).

this category if they focus on climate change. For the remaining companies, climate change is not likely to be a main source of profitability and growth, but they may gain legitimacy if they act visibly on the issue. For them, there is no compelling reason to develop capabilities in managing climate change. Their route to addressing the issue will be through external markets, e.g. purchasing technologies and emission rights, as well as by adopting expertise developed by outsiders.

For the development of sector-based activities and capabilities, it is crucial that the 'basic direction' of policy is 'positive'. There must be a signal that a carbon market or another type of mechanism with the same characteristics will continue to exist in whatever form or shape. This was shown for the CDM, where most activities took place in the period when rules offered more certainty (Kolk & Mulder, 2011). Still, companies can handle some uncertainty, as this is an inherent feature of business. Furthermore, and perhaps more importantly, most assume or expect energy costs to rise, pressures for emissions reductions to continue, and predominantly fossil fuel-based business models to recede at some point. Several energy-intensive companies are therefore engaging in a mix of lobbying and R&D activities to prepare for such changes, with the need for addressing climate change often now translated into adjustments in the energy base of business models. The extent of corporate strategic foresight is concerned not only with the types of activity, but also with company-specific assessments of (perceived) risks and opportunities in relation to 'green' investments broadly defined. In the management literature, several dimensions are acknowledged to play a role in this regard, including the leveraging potential and flexibility of such resource commitments (Rugman & Verbeke, 1998).

A high leveraging potential means that resource commitments help to improve companies' competitive advantage, which may result from a better performance in existing markets, from entering new markets, or from creating/enhancing technological capabilities. Flexibility is also important; when investments can be put to alternative uses, this facilitates corporate decision making, as a mistake may be corrected. Such a reversal may take place if investments' contribution to companies' performance is trivial or uncertain. In many cases, however, resource commitments are not very flexible and cannot be reversed easily. An exit barrier is therefore created, as

some (fossil fuel-based) energy investments illustrate. If irreversibility is anticipated, this can also create a barrier to entry, with companies waiting until there is more certainty on all fronts. However, companies may still invest if the leveraging potential seems high, and such resource commitments are likely to contribute to unique corporate capabilities with high complexity and much tacit knowledge, to generate high profits, and/or to reap reputational benefits. However, this can be temporary, as technological and market developments may reduce the costs of alternatives (cf. declining prices of solar panels), and these changes make (carbon) lock-in unprofitable, while public perceptions are also volatile.

These managerial considerations are relevant for technology development, which predominantly occurs in developed countries (see below). Deployment and transfer applies to developing countries, but has been limited so far. In the case of multinational companies (the key actors in this regard), managerial considerations do play a role in these companies' resource commitments in their home countries as well as in other crucial (often developed/emerging-country) host markets. Furthermore, if multinationals decide to invest in (clean) technology in these main (home/developed) countries, then a first basic condition for possible transfer to other, less-developed, locations has been met. In the following, consideration is given to the factors that need to be taken into account in relation to home-/host-country contexts and international business, with attention to the potential for technology transfer.

3. Country-specific factors relevant to international business

In the absence of a real enforceable global agreement, multinationals are confronted with a patchwork of policies in the various countries in which they operate, some restricting emissions, others encouraging renewable/cleaner activities. Recent articles in the field of international business have shed more light on multinationals' climate-related resource commitments, both conceptually (Kolk & Pinkse, 2008; Pinkse & Kolk, 2012) and empirically, in relation to foreign direct investment in renewables (Hanni, Van Giffen, Krüger, & Mirza, 2011; Kolk, Lindeque, & van den Buuse, forthcoming; UNCTAD, 2010). Government policies have been important, taking various forms

ranging from the provision of public subsidies, knowledge, and infrastructure, to market creation and regulation, including the protection of intellectual property rights, investment facilitation and/or promotion, and international (green) development assistance.

Multinationals have profited, particularly if their home country has been at the cutting edge of green technology, a situation often related to (pro-)active climate/energy policies. Examples include German and Spanish multinationals, which have built competences as a result of domestically offered subsidies/tax breaks, which they could leverage abroad at a later stage. In this way, they have benefited from subsequent grants in other countries through their local subsidiaries. This happened with wind energy stimulus funding in the US, which mostly went to European multinationals. Interestingly, US multinationals could not profit from activities undertaken in their foreign subsidiaries, as the 'local-content' clause stipulated US-based companies only. Localization requirements in some other countries such as China and South Korea have tended to favour domestic green-energy companies, as they have been best (politically) embedded in the domestic settings. Overall, home-country factors have been the main drivers for low-carbon foreign direct investment.

It should be noted that the debate on climate-related investments is based on data from developed and, to a much lesser extent, emerging countries, with developed-country multinationals predominating, in line with the examples given above. Even if attention is given to developing countries in general, any conclusions will stem from evidence originating mainly from emerging economies, particularly China and India (Hanni et al., 2011; Pueyo, Mendiluce, Naranjo, & Lumbreras, 2012), and in the case of the CDM, also Brazil and Mexico (Dechezleprêtre et al., 2008, 2009). For example, while developing countries have attracted substantial greenfield investments in renewable energy manufacturing, the overwhelming majority of investment has gone to a few emerging economies (Hanni et al., 2011; UNCTAD, 2010). This means that recommendations flowing from these studies (as well as policy reports; e.g. Blanco, De Coninck, & Würtenberger, 2012), which emphasize the need for strong institutions, government support, clear signals and incentives, as well as innovative local companies and sufficient absorptive capacity, are difficult to implement as they refer to conditions typically lacking in the least-developed countries.

In addition, multinationals' renewable foreign investments in developing/emerging countries generally involve established technologies (biomass, hydroelectric, geothermal), for which the transfer of technology, as such, tends to be limited. This further reduces the value of insights from current data and patterns established thus far. Still, multinationals can transfer skills and knowledge, and create linkages with buyers and suppliers, aspects that relate to other mechanisms that have been identified in the literature in connection with the impact of multinationals on development (cf. Fortanier & Kolk, 2007) and cross-border market (co-)creation (Pitelis & Teece, 2010). Benefits to local economies may also be limited due to the fact that multinationals' renewables activities abroad are predominantly greenfield investments, and not other types such as joint ventures, alliances, or licensing agreements with potentially larger spillovers.

Given all these limitations, are there additional insights that might be offered on the possibilities for clean technology transfer to least developed countries? Some suggestions are offered below, which also consider recent studies on business, energy, and development more broadly.

4. Some implications and suggestions

When considering the state of foreign direct investment in renewables (activities that seem most relevant to climate change issues), it can be concluded that even though least developed countries have barely been involved, the past decade has seen a considerable growth in both energy generation and equipment manufacturing projects, with developed-country utilities as leading investors (Hanni et al., 2011; Kolk et al., forthcoming; UNCTAD, 2010). Data show that companies from the first category (see Table 1) are most important for renewable-energy generation investment, partly as a result of the competitive advantage built up via their European home-country contexts, as well as the saturated domestic markets, reflecting a specific combination of the three factors identified in this article (sector, company, and country peculiarities). In environmental technologies manufacturing, the picture is slightly more diverse, with more companies from the second category and from home countries such as the US and Japan as well. However, renewable-energy companies have recently experienced difficulties in sustaining

their business. In terms of renewable-energy technologies, wind has dominated to date (followed by solar), and has focused on developed-country contexts. Emerging economies have also seen domestic and some multinational investment in these technologies, but biomass, hydroelectric, and geothermal energy have prevailed in such countries.

Nevertheless, despite the limitations in terms of types of technology and targeted countries, there is a base now, with domestic and foreign experience being built up. Although market-seeking and cost-efficiency factors have thus far been most important for these international investments, there seems to be a potential for extending current activities to less-developed areas. If a focus on less-developed (sub)regions/countries does not fully match with corporate ambitions in terms of flexibility and leveraging potential (which would otherwise result in a focus on emerging countries with large market potential), investments may be facilitated by targeted public policies and/or sources of funding, or set up as public-private or public-private-non-profit partnership efforts. This also offers possibilities to deal with difficult institutional settings where the domestic so-called 'enabling environment' is largely lacking, as indicated above, and to allow for some 'trial and error' and 'learning by doing'. In a sense, markets may need to be (co-)created through interactions between multinational foreign direct investment and home/host/international policies (cf. Dunning & Lundan, 2010; Pitelis & Teece, 2010). The local entrepreneurship that has emerged in renewable (off-grid) energy in developing countries might be helped through partnerships and

linked to multinationals and potential sources of funding, knowledge, and expertise from business, government agencies or NGOs. The better such initiatives can be connected to multinationals' networks and involve those companies that have experience with operations in least-developed areas, the greater the possibilities for technology transfer/deployment and for successful and profitable activities. Sometimes, official development assistance (or its private-sector development subheading) is also being used to support such partnerships, with government agencies offering institutional support, in least-developed countries themselves.

Although it is still difficult to find viable business models for renewable energy, particularly in poor and remote areas, a variety of modalities have emerged over the years, ranging from fully commercial to primarily publicly funded, with 'subsidies' through partnerships or corporate sponsoring (corporate social responsibility or philanthropy) in between (Global Sustainable Electricity Partnership/UN-Energy, 2012; IFC, 2012; Kolk & van den Buuse, 2012). The three main categories relevant for the purpose of this article are briefly indicated in Table 2, with market co-creation (which seems the main route for commercial perspectives in the shorter to medium term) in the middle. Linking these modalities to the different types of companies from Table 1, there is a clear role for companies in high-salience sectors as they can merge their interest in moving to lower-emission activities with expertise built up in large-scale projects; this seems most relevant for (European) utilities that have already engaged in cross-border operations, although usually not in least-developed

TABLE 2 Different business model modalities

Fully company-funded; commercially viable	Only in developed countries and some emerging countries Difficult to start, let alone sustain in least-developed countries
Co-funded/sponsored; not yet commercially viable	Market co-creation with support from both public and private actors Companies provide funding via corporate social responsibility efforts, in partnership with NGOs, or by 'private protection' mechanisms (no/lower requirements for internal return on investment in this phase)
Fully government-funded; commercial viability not in sight	Areas without commercial interest, at least not in the foreseeable future (e.g. isolated rural areas in least-developed or conflict-affected/fragile states) Will require dedicated funds via joint international efforts (government or corporate philanthropy)

countries (Kolk et al., forthcoming). Companies specializing in clean energy and environmental technology (the second category in Table 1) may also be involved in view of the co-creation of (future) markets. They may allocate internal resources in a 'protected' mode, shielding these investments from normal rate-of-return requirements (cf. Pinkse, Bohnsack, & Kolk, forthcoming). The remaining companies, which have no interest in the issue directly, may gain legitimacy if they support clean energy, e.g. via sponsoring or purchasing offsets.

As a final note, it is interesting that international activities in the least developed countries in relation to renewable energy have recently been accelerated through the 'sustainable energy for all' initiative undertaken by the United Nations, as this has led to more attention and greater concentration of (funding and partnership) efforts. Its focus on renewable energy technologies and access to energy for all, particularly the rural poor, seems to offer large potential for also addressing climate goals in developing countries as attempts are made to upscale clean electricity generation and renewable energy. If these different activities focusing on lower emissions and on transfer and deployment of renewable energy technologies can be combined, while leveraging partnerships and their sources of expertise and (both public and private) funding, then climate change objectives may also be served. Perhaps this might be a way to partly sidestep the controversies in the climate change debate by leveraging the momentum of 'sustainable energy for all', including major efforts to reduce emissions and further clean energy investments in and transfer to least developed countries.

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