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A PERSPECTIVE ON MULTINATIONAL ENTERPRISES AND CLIMATE CHANGE: LEARNING FROM 'AN INCONVENIENT TRUTH'?

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Abstract

This paper explores whether and how an important environmental issue such as climate change can give MNEs not only the opportunity to develop 'green' firm-specific advantages (FSAs), but also help reconfigure key FSAs that are viewed as the main sources of firms' profitability, growth and survival. We examine the nature and geography of such FSA development, and develop two organizing frameworks, which are subsequently applied to climate change, using information from Global 500 firms. Implications and future directions for IB research are indicated.

Key words

Firm-Specific Advantages; Capabilities and Capability Development; Location-Bound Knowledge Bundles; Climate Change; Sustainability

A PERSPECTIVE ON MULTINATIONAL ENTERPRISES AND CLIMATE CHANGE: LEARNING FROM 'AN INCONVENIENT TRUTH'?

Introduction

Sustainability related to multinational enterprises (MNEs) has received increasing attention in the past decade (Lundan, 2004; Rugman & Verbeke, 2001a). In the academic International Business literature, a major contribution to a better understanding has originated from Rugman and Verbeke, in a series of publications in the late 1990s (see especially Rugman & Verbeke, 1998; 2000; 2001a). Particularly their attempts to link sustainability to general themes, such as internalization, location-bound and nonlocation-bound firm-specific advantages (FSAs), competitiveness, public policy and MNE strategy, have been valuable. Considering this work, of which the last publication was written around 2000, there are some obvious areas of further research building on Rugman and Verbeke, all the more because in recent years concern about MNEs' impact on sustainability issues with a global scope such as climate change, the hole in the ozone layer and biodiversity loss has become more pressing than ever before.

Yet, to what extent MNEs are also taking the responsibility to become agents of global change that tackle sustainability issues is still highly debated (Christmann, 2004; Christmann & Taylor, 2001). It is without doubt that MNEs have a huge potential for innovation, which might lead to the development of sustainable products and services (Hall & Vredenburg, 2003). But, do MNEs also take the effort to invest in sustainable technologies, and if so, how far are they willing to go, also if this means moving away from technologies they are familiar with? This 'frontier' of International Business research seems very worthwhile pursuing because it links the sustainability implications of corporate activity and the policy and societal responses engendered to the actual strategic responses of MNEs, particularly the competitive (dis)advantages that may be created (or not) at different locations. It thus sheds light on how a global sustainability issue affects configurations of country-specific and firm-specific advantages, and may incite MNE activities that help shape the (sustainable) future of societies worldwide.

The decision of an MNE to invest in tackling a global sustainability issue can be assessed with Rugman and Verbeke's (1998) resource-based framework on environmental management that explains in what instances it is likely that MNEs will commit resources to improving environmental performance. They argued that resource commitments to activities such as pollution prevention and waste reduction have a strategic use only if they lead to the creation of 'green' FSAs. Whether this is the case depends on the *leveraging potential* of resource commitments and the *flexibility* regarding their reversibility. Leveraging potential indicates whether committing resources to environmental management leads to creation or improvement of FSAs that simultaneously advance environmental and industrial performance. Rugman and Verbeke (1998) argue that environmental investments have this potential if they enable MNEs to improve performance in existing markets, enter new markets, or boost technological capabilities valuable for the long run. Flexibility, on the other hand, makes it easier for firms to decide upon resource commitments as mistakes can be corrected. Preferably, firms end up in a green success scenario where resource commitments for environmental improvement have a high leverage potential and are flexible. In many cases, however, environmental investments cannot easily be reversed and firms run the risk of ending up in a green mistake scenario, in which inflexibility is accompanied by a weak leveraging potential. As a result of this looming danger, firms may be hesitant to engage in this kind of investments. If uncertainties exist in the environmental arena, for example with regard to regulatory instruments, consumer responses and industry standards, firms are likely to postpone decisions until new environmental options are economically superior as well.

Apart from adding insights from the resource-based view by highlighting in what instances environmental regulation can lead to the development of green FSAs, Rugman and Verbeke (1998) have shown the value of adding country-specific advantages (CSAs). MNEs are not only confronted with the issue whether or not to develop green FSAs, but also with the fact that environmental regulations differ between countries in which they operate. They argued that changes in environmental regulations could fundamentally alter CSAs for specific countries. The strategic complexity for MNEs is that they have to combine FSAs and CSAs, which usually means adapting FSAs, to attain optimal FSA-CSA configurations (cf. Rugman & Verbeke, 1992; 2003).

Notwithstanding the contribution of Rugman and Verbeke's (1998) framework to gain insight into the decision of MNEs whether or not to invest in improving environmental performance and how this differs across countries, it does not tell how MNEs maintain existing or create new FSAs for managing a global sustainability issue over time. Assessing the impact of such a global issue on MNE strategy is quite challenging because it is far more complex than responding to specific local environmental regulation, for example in the case of air pollution or chemical substances laws. The role that a global sustainability issue plays in MNE strategy is not merely a matter of dealing with local regulation, but usually part of a broader conglomerate of factors involving not only governmental but also societal and market forces, and at different levels, national, regional and/or international. Due to this whole variety of geographically dispersed forces that influence the development of a global sustainability issue, meeting all stakeholder demands essentially forms a moving target for MNEs. What is expected from MNEs constantly changes because public opinion, regulation, competition and scientific evidence on global sustainability issues usually follow a rather fitful course.

This means that a one-time decision to commit resources does not suffice. Instead MNEs have to constantly adjust their FSAs for deploying these resources or even create new FSAs to maintain fit with changes in the global sustainability issue. In other words, because MNEs face a moving target they require dynamic capabilities (Teece, Pisano & Shuen, 1997), and keep modifying and transferring FSAs to stay responsive to issue-relevant CSAs across the globe as well as higher order learning to keep abreast of future developments that may affect key FSAs (Winter, 2003; Zollo & Winter, 2002). Taking a dynamic capabilities perspective can thus help to uncover whether and how particular global sustainability issues incite MNEs to build green FSAs or reconfigure their key FSAs that are viewed as the main sources of profitability, growth and survival. It provides insight in the strategic changes that MNEs implement to tackle issues of global sustainability and how these differ between geographic locations in which an MNE is active.

To examine whether and how particular global sustainability issues induce MNEs to build green or change key FSAs, this paper focuses on the issue of climate change. Over the past decade this global issue has evolved as the most pressing environmental problem of our time. Particularly due to temperature increases, it already affects physical and biological systems by changing ecosystems and causing extinction of species, and will increasingly have a social impact and adversely affect human health (IPCC, 2007). What is more, as a result of the economic costs and risks of extreme weather (Romilly, 2007), climate change could have a severe impact on economic growth and development as well, if no action is taken to reduce emissions (Stern, 2006). Consequently, climate change affects MNEs active in a wide variety of sectors and countries. It is also not a 'purely' environmental issue because it is closely linked to concerns about energy security due to dependence on fossil fuels and oil in particular, and to energy efficiency and management more generally. Over the years, the strategic impact of climate change has been surrounded with great uncertainty (Brewer, 2005) (e.g. uncertainty about type, magnitude, and timing of the physical impact; about the best technological options to address the issue; as well as about the materialization of public policies). It has been a long time since the first deliberations on regulation of greenhouse gas emissions started, around fifteen years ago, until sufficient ratification and thus entry into force of the Kyoto Protocol, in early 2005. The adoption of the Kyoto Protocol in 1997, however, already set some things in motion, such as an emissions trading scheme in the EU (the EU-ETS which started per 1 January 2005), but for firms the overall policy context has been ambiguous with a range of national and international initiatives, some binding, others voluntary, and with a multitude of actors involved.

Increasing societal and regulatory attention to the issue has led MNEs to consider how it affects markets in which they operate and has engendered a variety of responses, both market and non-market (political) in nature (Kolk & Levy, 2004; Kolk & Pinkse, 2005; 2007; Levy & Kolk, 2002). MNEs clearly show awareness of growing public concerns that have come to the fore in press coverage but also through popular books and movies on this 'inconvenient truth', as one of them was titled. However, due to the fact that MNEs have been facing a complex international context of continuously changing climate policies, many tend to be cautious in taking steps in one particular direction. They clearly doubt the flexibility of climate-induced investments and fear to make irreversible green mistakes (cf. Rugman & Verbeke, 1998). What is more, tackling climate change effectively might require firms to move away from existing technologies and build new, unrelated FSAs instead. For these reasons, the vast majority has only recently started developing FSAs in response to climate change. Nevertheless, quite a few early movers, particularly in those sectors most confronted with it, have anticipated the ambiguities surrounding climate change by seizing the opportunity to gain a strategic advantage over their rivals (Hoffmann, 2005). It is also an issue from which MNEs can learn how to anticipate future developments in a context of uncertainty and exercise leadership that combines societal and strategic concerns.

To explore in more detail how a global sustainability issue may affect an MNE's FSAs, we examine existing literature, particularly concerning the nature and geographic location of FSA development, and develop two organizing frameworks, one for each aspect. These are subsequently applied to climate change to indicate what will induce MNEs to develop so-called climate-induced FSAs. For these sections on firms' actual positions and activities on climate change, we used illustrative information from various sources, including those that have come available through the second cycle of the Carbon Disclosure Project (CDP), published in May 2004. For the CDP, MNEs disclosed wide-ranging information on initiatives currently underway to reduce greenhouse gas emissions. We used the CDP to identify specific cases of MNEs that have become engaged in the development of climate-induced FSAs in whatever form. After that identification we subsequently collected additional archival information about the cases from corporate sustainability reports, research reports from NGOs and carbon consultants, and one international financial newspaper – the Financial Times. As the aim of the study is to explore what the response of MNEs to climate change brings in terms of ideas and further research directions regarding FSA development, this empirical information is presented to illustrate the theoretical concepts.

The nature of climate change-induced FSA development

Before we analyze FSA development induced by global climate change, we first give a conceptualization of FSAs and how they compare to capabilities (a concept more often used in strategy). Rugman and Verbeke (1992) have argued that FSAs consist of proprietary knowledge as well as the capability to coordinate and control geographically spread assets of an MNE. In due course, they have rephrased their view on FSAs as 'knowledge bundles that can take the form of intangible assets, learning capabilities and even privileged relationships with outside actors' (Rugman & Verbeke, 2003: 127). The FSA-concept is thus strongly aligned with that of a capability[1], which Amit and Schoemaker defined as 'a firm's capacity to deploy resources, usually in combination, using organizational processes to effect a desired end' (1993: 35). The added value of Rugman and Verbeke's framework, however, is that it takes note of the consequences of cross-border activities for competitive advantage by putting emphasis on one capability in particular, that is, managing geographically spread assets. MNEs do not only seek to develop FSAs but will also optimize their FSA-CSA configurations by taking specific conditions of home and host countries into account.

But how will climate change induce MNEs to transform existing FSAs or build new FSAs? Looking at the activities that MNEs initiate in response to a sustainability issue gives insight into what extent they change FSAs (cf. Aragón-Correa & Sharma, 2003). Examples of FSA development are product differentiation based on improving environmental quality for which consumers are willing to pay a premium (Reinhardt, 1998) and in-house development of pollution prevention technologies to lower environmentally induced costs (Christmann, 2000). It must be noted though that not all environmental management activities lead to a change in an MNE's FSAs. For example, many technologies to control pollution, which have been developed in response to environmental regulation, have a negligible effect on competitiveness (Hart, 1995; Russo & Fouts, 1997). For most issues the impact and type of FSA development depends on the industry in which an MNE is active. Legislation to stop ozone depletion, for example, had a strategic impact on the chemical industry but largely no effect on other industries, because the chemical industry was the main source of the harmful emissions (Levy, 1997). Climate change, on the other hand, is likely to have a strategic impact on growth, survival and performance of firms across a much wider range of industries and is more likely to affect activities that form the core business of an MNE (Hall & Vredenburg, 2003).

The impact of climate change is multi-faceted in the sense that for MNEs it involves responding to regulatory action as well as potential market developments and competitor responses

(Kolk & Levy, 2004). One factor that determines the impact of climate change is the technological change that its emergence brings about (Hall & Vredenburg, 2003) as well as the reaction of MNEs to this change (Helfat & Peteraf, 2003). Climate change may lead to technological change for some industries but for others it will not, and, when it has an effect on technology, it may either enhance or destroy existing capabilities of incumbent firms (Abernathy & Clark, 1985; Tushman & Anderson, 1986). A competence-enhancing discontinuity creates a major change in a firm's technology which nevertheless still builds on existing capabilities; while a competence-destroying discontinuity necessitates firms to develop completely new capabilities as existing ones have become obsolete (Tushman & Anderson, 1986). It thus depends on a firm's existing capabilities whether a technological change is competence-enhancing or destroying (Gatignon, Tushman, Smith & Anderson, 2002). Still firms have a choice how to react to technological change (Helfat & Peteraf, 2003); they can for example decide to build on existing capabilities, fundamentally change capabilities within the firm or acquire new capabilities from outside the firm (Gatignon et al., 2002; Lavie, 2006). If existing FSAs of incumbents still have value even with a change in technology, they can exert considerable influence in which direction FSA transformation moves (Helfat & Peteraf, 2003; Rothaermel & Hill, 2005; Tripsas, 1997) and thus also to what extent climate change is taken aboard.

Lavie (2006) developed a framework that is useful to examine the process by which firms adapt their FSAs in response to technological change caused by climate change. The framework presents three capability reconfiguration mechanisms – *capability evolution, capability transformation and capability substitution* – that represent ways in which incumbents modify existing capabilities when confronted with technological change. Capability evolution is an incremental learning process, which relies on a firm's dynamic capabilities (Lavie, 2006) to accommodate technological change in a competence-enhancing way. Dynamic capabilities refer to the competence of firms to renew the configuration of their FSAs to maintain a fit with a changing business context (Teece et al., 1997) and can be thought of as value-creating processes within an MNE such as product development, strategic decision-making or forging alliances (Eisenhardt & Martin, 2000). Basically, capability evolution does not replace routines but only modifies and adjusts them by using internal sources of knowledge. As a consequence, path dependencies determine how existing FSAs evolve over time. In other words, through experimentation FSAs change over time, but the way in which they alter depends on a firm's particular history and rigidity of existing FSA configurations (Lavie, 2006). For incumbents capability evolution may well be the preferred mode of change because it builds on existing FSAs accumulated over time, thus exploiting asset mass efficiencies (Dierickx & Cool, 1989). However, following this route will not necessarily lead MNEs to become agents of global change that significantly improve the condition of the planet because they keep looking at markets of the past instead of the future (Hart, 1995).

The other two mechanisms are more promising in this respect, as they take more note of future contingencies (Lavie, 2006). In the case of capability transformation existing FSAs are not completely discarded either, but some of the routines that are part of the FSA are modified or newly acquired as a firm opens up to external sources of knowledge. In a transformation process the reconfiguration takes place on the level of the FSA. Still the FSA keeps its function, but does so in a different way because of the change in underlying routines. An FSA that is formed through transformation thus consists of past as well as new knowledge and skills (Lavie, 2006) and is at the same time competence-enhancing and competence-destroying (Gatignon et al., 2002). Capability transformation is more forward-looking and involves higher-order learning as not only some of the routines that form the FSA change but also the dynamic capabilities that shape the FSA (Zollo & Winter, 2002). For example, higher-order learning takes place when MNEs improve understanding of a sustainability issue, which in turn leads to new R&D activities that make production processes less polluting (Sharma & Vredenburg, 1998). FSA transformation holds quite some promise for the role MNEs play in dealing with climate change, because it leaves the function of key FSAs intact while simultaneously enabling them to find ways to help the planet. For MNEs FSA transformation seems to be a more realistic option than capability substitution, the third reconfiguration mechanism. Capability substitution assumes competence-destroying technological change which causes a firm's whole portfolio of existing FSAs to become obsolete. This means that the configuration of existing FSAs does not alter, but the value of the FSAs disappears (Lavie, 2006). For substitution to take place a firm must acquire a completely new portfolio of FSAs that take the place of the existing one, as no changes are made to the FSAs that lost their value. This basically means that MNEs have to acquire all new FSAs from outside the firm (Lavie, 2006), as it will be difficult, if not impossible to bring about competence-destroying change from within the firm (Gatignon et al., 2002). A major challenge for MNEs in deciding what course of action to follow is to assess a priori what kind of technological discontinuity climate change will trigger, as its actual impact will only be known in retrospect (Tushman & Anderson, 1986).

How far MNEs are willing to go in taking responsibility for climate change and to what extent this contributes to competitive advantage also depends on the potential spillover effects of technological change throughout the value chain (Hall & Vredenburg, 2003). Formulated more broadly, it makes a considerable difference to MNEs whether the issue either affects their upstream (back-end) or downstream (customer-end) activities, or has an impact on the complete value chain all at once (Rothaermel & Hill, 2005; Tripsas, 1997). Depending on the precise impact of climate change, it may induce an MNE to develop FSAs related to upstream activities for production, R&D, and sourcing of raw materials, capital and labor (Rugman & Verbeke, 2004; Rugman, 2005). For example, one possibility is that climate change leads a firm to create an FSA from developing a climate-friendly technology through upstream R&D activities, which is then commercialized by way of existing downstream FSAs in market-related activities. However, it may also lead to a change in downstream activities for the customer-end of the value chain including sales, marketing, and distribution (Rugman & Verbeke, 2004; Rugman, 2005). By developing green FSAs in downstream activities, such as green marketing, an MNE could not only commercialize existing technologies that have previously unexploited green attributes, but also create an FSA out of a purchased technology. In both instances, the rise of climate change can have a positive impact on MNEs, because they can leverage some of their existing upstream or downstream FSAs, which creates a buffer from competitors (Tripsas, 1997). A more challenging case, however, is when climate change disrupts FSAs throughout the whole value chain. If MNEs are able to adapt both upstream and downstream activities simultaneously, this will contribute more to a sustainable competitive advantage, because such investments will be more difficult to imitate (Verbeke, Bowen & Sellers, 2006), and lead to higher-order capabilities of combining technological (upstream) and nontechnological (downstream) FSAs

(Rothaermel & Hill, 2005). However, it will also be riskier for MNEs to accommodate the change because they cannot leverage existing FSAs and thus open the door to new entrants. Hence, MNEs may also have an incentive to attempt at obstructing such a change (Tripsas, 1997).

Figure 1 presents a framework that depicts the nature of climate-induced FSA development; it should be noted though that this can be applied more broadly as well. The vertical axis refers to the three FSA reconfiguration mechanisms: FSA substitution, FSA transformation, and FSA evolution. This axis measures how radically MNEs change their key FSAs in response to climate change. The three mechanisms form a continuum where FSA substitution is the most drastic response to external change followed by transformation and evolution. The horizontal axis corresponds to the value chain orientation of FSA development. It shows whether an MNE changes FSAs related to downstream activities aimed at customers or those related to upstream activities such as sourcing and production. The ensuing matrix sets out six cells in which particular initiatives of MNEs in response to climate change can be positioned and shows how MNEs adapt their FSAs.

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Figure 1 around here

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Applying the framework to MNEs' climate activities

A closer look at MNEs' climate activities first shows, as might have been expected in view of their climate impact, that particularly MNEs in the oil and gas, automotive and electric utility industries are developing climate-induced FSAs. The currently prevailing technological FSAs of these industries are the main source of carbon emissions, because they rely on the combustion of fossil fuels. But as fossil fuels also comprise an important part of the production process of many other manufacturing industries (e.g. chemicals, steel, and electronics), climate-induced FSA development is not restricted to MNEs that produce cars, oil and gas, or electricity.

To begin with the car industry, several events can be discerned in this industry that point at developments regarding a change in this industry's key FSAs. Major players in the car industry seem to agree on the idea that hydrogen-powered fuel cells will replace the internal combustion engine in coming decades. The fuel cell vehicle is climate-friendly because it will remove direct carbon emissions from cars.[2] The launch of the fuel cell vehicle would thus mean that car producers could be positioned in cell 4 – upstream FSA transformation – of figure 1. The technology is aimed at upstream FSAs as it involves changes in R&D and production from modifying the car engine. It is a case of FSA transformation because the FSA portfolio as a whole keeps its function (producing cars); only the underlying routines will change as a result of the fuel cell technology. But why is it taking the car industry so long to commercialize the fuel vehicle? An explanation is that, on top of the fact that it is difficult to develop the fuel cell vehicle itself, it also requires a substitution at the customer-end of the value chain. The car industry is relying on chemical and energy industries to supply the hydrogen necessary to attract prospective customers. This necessitates a major breakthrough in the production and distribution of hydrogen, which has not occurred yet because it could be a competence-destroying change for suppliers of fossil fuels. As the car industry will not be able to supply the hydrogen itself, it thus faces a major barrier in bringing the fuel cell vehicle to the market.

To overcome this barrier many car firms first invest in so-called transition technologies, which are predominantly competence-enhancing. This serves several purposes: it allows them to satisfy short-term demand for fuel-efficient and climate-friendly cars, it helps in establishing a green brand image (Anderson & Gardiner, 2006), and it creates the asset mass efficiencies (Dierickx & Cool, 1989) necessary to build the fuel cell vehicle.[3] For example, Ford and BMW are developing the hydrogen-powered internal combustion engine, which Ford (2004) views as 'a "bridging strategy" using existing, proven technologies to deliver the environmental benefits of fuel cells at a fraction of the complexity and cost.' More accepted, however is hybrid technology, which is illustrated by DaimlerChrysler's (2004) following statement:

> For the future we view the fuel cell as the technology, which has in the long term the most significant potential of reducing the CO_2-emissions of our products. […] Today we focus on three steps to reduce CO_2-emissions: the continuous improvement of conventional

combustion engines, the hybrid technology as the bridge between the conventional powertrain and the fuel cell as the most efficient technology for reducing CO_2.

Firms including Toyota, Honda, Nissan, Ford, and General Motors follow a path similar to DaimlerChrysler by offering hybrid cars. However, while Toyota and Honda have gained experience by developing the technology in-house for almost a decade, others including Ford and Nissan have only quite recently licensed the technology from Toyota (Mackintosh, 2004). As a consequence, Ford and Nissan are not likely to create an upstream FSA in developing hybrid cars because they miss out on the asset mass efficiencies, but merely anticipate a short-term increase in demand for fuel-efficient vehicles due to higher fuel prices. This is illustrated by the fact that Nissan has recently ended the license agreement and decided to build its own hybrids instead, because the market for hybrids has surged beyond expectation (The Yomiriu Shimbun, 2006).

Toyota's leadership in hybrids is an exemplary case of a firm that has been combining technological and nontechnological capabilities. It was the first to develop the hybrid technology, but the technology became a success because it made good managerial decisions (Helfat & Peteraf, 2003), such as licensing the technology which led others to also offer hybrid cars, thereby creating market acceptance (Spencer, 2003). Toyota has also successfully betted on future contingencies, that is, they anticipated increasing consumer awareness for fuel prices and the environment, which has spurred the demand for fuel-efficient vehicles. Particularly in the US, it has been easier for the Japanese car firms to position themselves as suppliers of fuel-efficient, clean cars, because traditionally they have stronger credentials in the small-car segment (Simon, 2006a). In other words, for the Japanese firms offering fuel-efficient vehicles merely involves an evolution in downstream FSAs (cell 1), they apply their dynamic capabilities to keep a fit with a change in consumer preferences in favor of climate-friendly cars. For US firms, on the other hand, it may entail a transformation in downstream FSAs (cell 3), because they are strong in large cars, e.g. sports utility vehicles, producing small fuel-efficient cars is somewhat competence-destroying.

While most car firms focus on the technological attributes of car engines, thus changing attributes of their product, General Motors, Ford, Volkswagen, Volvo, and DaimlerChrysler also have a fuel strategy. These firms for example contribute to the development of biofuels, by which they aim to create an upstream-oriented FSA. This strategy does not have a large impact on upstream FSAs in R&D and production because using biofuels only requires modest changes to the engine of a car. Its upstream impact may be considerable though as car producers try to push new kinds of fuel suppliers for the users of their cars – a shift towards suppliers that produce ethanol and biodiesel instead of petroleum-based fuels, e.g. the largest US ethanol producer Archer Daniels Midland (Harvey, Cameron & Beattie, 2006). Even though it is not to be expected that these car firms will turn into large-scale biofuels producers themselves, in adapting their cars they will cooperate more with these biofuels suppliers. A fuel strategy can thus be positioned in cell 2: upstream FSA evolution.

Developments in the oil and gas industry more clearly illustrate the trend of firms that eventually will have to go for a competence-destroying FSA substitution of their upstream and downstream activities (cell 5 & 6) through a fundamental change in their portfolio of key FSAs throughout the whole value chain. However, in what direction this substitution will take place and which technologies will prevail in the coming decades is still unclear. While for the long term firms such as BP, ChevronTexaco, ENI, Royal Dutch/Shell, Suncor, and Total invest in renewable energy sources, others including BHP Billiton, ENI, and Royal Dutch/Shell also emphasize the development of hydrogen, which is an energy carrier not an energy source. All these developments require a sharper reconfiguration of the existing FSA portfolio compared to the car industry. Not only will the underlying technology of the main product – energy – change, but also other downstream processes such as distribution and sales. For example, a renewable energy source such as solar energy hardly builds on existing upstream FSAs in R&D and production. Technologically, producing solar panels is much closer to the semiconductor industry, which has experience with processing silicon, the main raw material for solar panels (Pernick & Wilder, 2007). Similarly, although oil firms are investing in wind power, it is a capital good producer like General Electric that has an FSA in producing wind turbines. Moreover, both renewable energy technologies may lead to a system of decentralized energy distribution, and thus threaten centralized energy distribution, currently a key FSA of the oil industry. It is thus not surprising that the majority of the oil firms invest in these renewable technologies marginally. Only BP and Royal Dutch/Shell have been relatively active through some investments in renewable energy, particularly solar power. BP has recently tried to give this business segment an extra impetus by launching their BP Alternative Energy campaign, thus attempting to create a downstream FSA in renewable energy.

Nevertheless, current developments in the oil and gas industry also share some similarities with the car industry; oil and gas firms also invest in competence-enhancing transition technologies, thus choosing an evolutionary path at first. A statement by Royal Dutch/Shell (2004) illustrates the role of transition technologies in the oil industry:

> Given that natural gas has the lowest carbon emissions per unit of energy produced (e.g. electricity) of all the fossil fuels, it offers the world an important bridge to a lower carbon economy as alternative energy technologies are developed and allowed to reach economic maturity.

In the choice for transition technologies many oil and gas firms take their initial FSA configurations as starting point for the development of climate-induced FSAs, thus showing the importance of path dependencies (cf. Helfat, 1997). MNEs that already have a strong position in the production of natural gas, such as BG Group, BP, ENI, ExxonMobil, Halliburton, Norsk Hydro, and Royal Dutch/Shell, conceive the changing context due to the emergence of climate change as an opportunity to strengthen this segment of their firms. ExxonMobil (2004) exemplifies this:

> As a leading supplier of clean burning natural gas, ExxonMobil is well positioned to contribute to efforts to address greenhouse gas emissions through fuel switching.

For firms that more heavily rely on the production of coal, climate change is a driver to develop other transition technologies. BHP Billiton and Rio Tinto, which have strong positions in the production of coal, both invest in clean coal technology and technologies to offset emissions by geological sequestration (the capture and storage of emissions in underground reservoirs). Oil firms such as Statoil and BP have also started to invest in carbon capture and storage, but do this cooperatively to spread the risk, thus creating a shared capability instead of an FSA. It thus seems that while the long-term strategies of oil and gas firms would mean a competence-destroying substitution of the complete

FSA portfolio throughout the whole value chain (cell 5), current developments more strongly indicate a competence-enhancing FSA evolution in downstream activities, merely marketing existing activities in gas and renewables more proactively (cell 1).

Whereas current activities in automotives and oil and gas hint at long-run developments whereby MNEs will eventually change (some of) their key FSAs, in other sectors such as electric utilities, chemicals, electronics, and metals & manufacturing, efforts focus more on developing green FSAs for the near future. Consequently, firms rely more on existing FSA configurations. They change some routines and their FSA base slowly evolves in a climate-friendly direction. Electric utilities, for example, draw on their key FSAs in generation, trade and sales of electricity to develop green FSAs. Most utilities are not involved in the development of renewable energy sources themselves, but instead purchase these from technology suppliers such as General Electric (cf. Marcus & Geffen, 1998). However, quite a few, including American Electric Power, CLP Holdings, Endesa, Exelon, Iberdrola, and Scottish & Southern Energy are expanding generation capacity that is based on renewable energy sources. Such a reconfiguration of energy sources for electricity production can be competence-enhancing, because utilities use their existing downstream FSAs to market energy to end-users. Iberdrola (2004), for instance, notes that it has a program for 'the promotion of electricity produced from renewable energy sources in the internal electricity market, making electricity users aware of the benefits of renewable energies.'

Another recent example of an MNE shifting attention to the green attributes of its technology development is General Electric, which launched its Ecomagination campaign. General Electric was already engaged in the development of wind turbines and clean coal technology, but decided to group clean technologies together under one brand (thus creating a green FSA in marketing) and increase investment in these technologies (Harvey, 2005). Depending on the success of marketing its green segment, a conglomerate like General Electric may eventually further expand this strategy. In other words, even though these firms do not change their key FSAs, they respond to climate change by using their existing key FSAs to develop green FSAs related to successfully marketing the sustainability attributes of their products. Nevertheless, such activities are not necessarily restricted to downstream sales activities, but may involve a change in upstream production, sourcing, and R&D

activities as well; it can thus put them in cells 1 and 2 simultaneously. Some firms also predominantly focus on sourcing, like British Telecom and Du Pont, which have decided to source a significant part of their energy consumption from renewable resources. It is arguable whether this leads to an FSA of their own, although some MNEs can undoubtedly put substantial pressure on their suppliers. Du Pont (2004) believes it can have such an impact and motivates its decision as follows:

> We will source 10 percent of our global energy use in the year 2010 from renewable resources. We are serious about the need for renewable energy to be a part of our future. We are providing a strong 'market signal' that there will be at least one major energy consumer ready to buy; and that we will work with suppliers of renewable energy resources to stimulate their availability at a cost competitive with best available fossil-derived alternatives.

Current evidence on MNEs' climate activities shows that most efforts are still evolutionary and particularly focus on downstream activities, which means MNEs market existing products differently with a stronger focus on green attributes. Nonetheless, this sometimes also entails investments in upstream production and sourcing activities to maintain fit with green FSAs in sales and marketing. Yet, current developments in the car industry do suggest some bolder steps leading to upstream transformation of FSAs, but with mixed success. Whereas hybrids are experiencing a breakthrough, fuel cells are still far away from being commercialized. An issue such as global climate change that has only recently started to attract business attention clearly does not immediately lead to radical changes such as a competence-destroying substitution of complete FSA portfolios of large MNEs. This is probably still only reserved for small niche players. In making climate-induced investments MNEs want to maintain their flexibility to safeguard their organizations against the uncertainties that exists about the future of international climate policy. Moreover, the risk of making an irreversible green mistake is quite high, because it is still unclear for many industries which climate-friendly technology will prevail in coming years.

The geography of climate change-induced FSA development

The preceding, first organizing framework on the nature of FSA development (Figure 1) looks at this process at a corporate level. However, this does not mean that developing FSAs to adapt to climate change merely occurs at MNE headquarters and is implemented uniformly throughout the global organization. As stated in the introduction, the role that climate change plays in MNE strategy is determined by a broad conglomerate of factors involving governmental as well as societal and market forces, working at different geographical levels. There may well be particular geographical factors that are conducive to a climate-induced change in FSAs, but this also means that it benefits the MNE at a specific location only. In other words, MNEs not only have the option to develop or change FSAs internally, but can also optimize their FSA-CSA configurations by taking specific conditions of home and host countries into account, such that CSAs form the starting point for FSA development (Rugman & Verbeke, 1992). Climate change thus adds new dimensions to what regionalization or globalization in terms of production and/or sales might mean for an MNE and its network, regarding possible spillovers of such concerns to other (core) activities and other locations, and how organizational responses are coordinated and controlled (cf. Rugman & Verbeke, 2004).

Climate change creates a geographically dispersed and moving target; while it may form a threat in one location, it can be an opportunity in another. Regardless of whether regional or local characteristics are seen as a potential advantage or disadvantage, liability or risk, geographical differences are something to be faced by MNEs and those firms that excel in doing this, are the ones most likely to develop climate-induced FSAs. Hence, learning from climate change does not merely mean that MNEs need dynamic capabilities to cope with technological change; constantly rejuvenating FSAs by being responsive to a wide range of climate change-relevant CSAs is what gives them an edge vis-à-vis competitors. For example, MNEs operating outside their home regions, upstream and/or downstream, may have difficulty in accommodating host-country concerns and approaches on climate change appropriately, often referred to as liability of foreignness (Zaheer, 1995). If the cost of dealing with host-country concerns becomes so high that it forms a serious threat, an MNE may choose to retire an FSA it once possessed in the host market or transfer it to another market (Helfat & Peteraf, 2003). On the other hand, spillover effects can also extend the impact of climate change to firms active in countries without stringent environmental regulations (e.g. in countries that refused to ratify the Kyoto Protocol) (Christmann & Taylor, 2001; Hoffman, 2005). This creates an opportunity for MNEs as they can replicate, redeploy, or recombine green FSAs, built up in countries with strict regulations (Helfat & Peteraf, 2003). Using geographically spread assets proactively in adapting to climate change is a dynamic capability in itself, which complements a change in FSAs in response to climate-induced technological change.

But what kind of geographical factors form climate change-relevant CSAs? In general, CSAs are factors such as availability of natural resources, access to markets to sell products and services, factor costs (labor, capital and land), and knowledge-intensive assets such as skilled labor and public infrastructure (Dunning, 1998). These factors form CSAs for all firms investing in a specific country (Makino, Isobe & Chan, 2004), and therefore attract MNEs driven by natural resource-seeking, efficiency-seeking, market-seeking or strategic asset-seeking behavior (Dunning, 1993). With the global intentions of the Kyoto Protocol it seemed at first that climate change policy would not result in climate-related CSAs, because it was intended to be quite homogeneous throughout the world. However, in spite of this global agreement, national regulatory responses have varied considerably since 1997, with the EU-ETS and the US rejection of Kyoto as two extremes, leading to a wide variety of climate-related CSAs after all. What is more, many countries in the EU and states in the US even have location-specific climate change regulations such as subsidies to stimulate investments in the development of renewable energy technologies (IEA, 2004).

CSAs are not only a result of a country's regulations; the broader institutional framework also plays a role (Makino et al., 2004). For example, the presence in the local context of a network of other firms or non-profit organizations that are in the process of developing climate-friendly technologies may be complementary to an MNE's own FSA development. Also consumer awareness of climate change may form a CSA, because it makes them responsive to green marketing campaigns. MNEs may benefit from climate-related CSAs either because they already own facilities in this particular location or because they move to these locations in an effort to seek strategic assets to complement their existing FSAs (Dunning, 1998). For example, strict environmental regulations in the home country may act as a CSA and incite MNEs to develop technologies by which they gain a competitive advantage over their rivals (Porter & van der Linde, 1995).[4] However, host-country locations can also form a potential source of FSAs, as an MNE's subsidiaries may tap into external local knowledge (Almeida & Phene, 2004). The EU emissions trading scheme, for example, has implications for home-region firms in particular, but also (potentially) for 'outsiders', host-region MNEs for which the EU is important in terms of production facilities and/or sales (Pinkse, 2007), and/or which compete with EU firms on non-EU markets. The locus (or loci) of origin of FSA development thus depends on the geographic spread of an MNE, as it is partly determined by the 'local' institutional context.

MNEs are thus confronted with a wide variety of climate-related CSAs (sometimes even state-specific advantages), which may incite the development of climate-induced FSAs. However, the impact that those climate-related CSAs have on the way MNEs transform existing or develop new FSAs depends to a large extent on the geographical origin of FSA development. If an MNE perceives climate change as a global issue, decision-making power on this issue will be at the level of its headquarters. In this case, an MNE believes that the consequences of climate change will have a significant impact on the firm globally, which is therefore dealt with at the highest management level. Headquarters' support considerably increases the potential that MNEs have for becoming global leaders in tackling climate change. However, since the worldwide institutionalization of climate change policies is still quite fragmented, many MNEs may also deal with the issue through their regional centers (e.g. decisions to participate actively in the EU-ETS), or national subsidiaries (Husted & Allen, 2006; Rugman, 2005). It then becomes a matter of local responsiveness to climate-related institutional pressures from regulators, NGOs, or the investment community (cf. Brewer, 2005). The more localized the decision is, however, the less likely it is as well that climate change will have a significant strategic impact on the MNE as a whole, because it will be quite difficult for a local subsidiary to convince MNE headquarters that climate change requires a proactive response. Instead of a global leader, an MNE may then produce local heroes instead.

This is not to say that a local response is of no use at all, however, if, through their subsidiaries, MNEs are located in countries that have been frontrunners on climate change, they have been facing climate-related pressures for a longer period of time already. This may have enabled them to start learning from the issue from an early stage on. Therefore, if a country initiates new regulations to curb greenhouse gas emissions this will probably be a much greater shock to domestic firms than to MNEs. Nonetheless, experience with climate change in a specific location will only create a cross-border advantage if they are able to transfer FSAs from other locations. Another question relating to the geography of climate-induced FSA development thus is whether MNEs will develop different types of location-bound FSAs that fit with CSAs of individual countries, or non-location-bound FSAs that can be transferred and deployed globally. The peculiarities of MNEs particularly arise from the potential to leverage non-location-bound FSAs. Similar or identical procedures for every subsidiary facilitates the exchange of experiences, it breeds internal consistency, enables for benchmarking and is clear to outsiders. Some MNEs, therefore, strive to harmonize their environmental management system and standards at all locations (Christmann, 2004). Yet, the situation in specific countries, for example, as a result of stakeholder or government pressure, may create location-bound FSAs as well (related to local responsiveness) (Rugman & Verbeke, 2001b). In some cases these can only be used in the country in question; in others they might help to increase MNEs' competitiveness elsewhere.

The transferability of an FSA typically depends on the attributes of the knowledge bundles that establish the FSA (Singh, 2007); the higher the tacitness of the knowledge, the less transferable it becomes (Kogut & Zander, 1993). A higher level of tacitness may be due to the extent to which an FSA results from linkages with external parties (e.g. governmental bodies, universities, or NGOs). These linkages are in general much better in an MNE's home country (or region), which explains findings that many MNEs are organized on a regional basis (cf. Ghemawat, 2003; Rugman & Verbeke, 2004). Host-country attributes also determine transferability of an FSA to a foreign location (Cuervo-Cazurra, Maloney & Manrakhan, 2007). Transfer of FSAs to relatively 'distant' countries (Ghemawat, 2001) in terms of dissimilarity of environmental regulations usually results in higher adaptation costs (in order to realize location-specific 'linking' investments) for alignment with the CSAs of these particular host countries (King & Shaver, 2001; Rugman & Verbeke, 2005). Tsai and Child (1997), for example, noted that transfer of environmental best practices is not always without problems. A global approach to environmental management usually relies on advanced technologies, but successfully implementing these in developing countries can be very expensive due to a lack of adequate infrastructure there.

Home and host-country attributes as well as the nature of the knowledge contained in an FSA together determine whether MNEs develop different types of location-bound FSAs that fit with CSAs of individual countries, or one non-location-bound FSA that is globally (or regionally) transferable. Although in the case of climate change a high potential for transferability can be expected, because most climate-induced FSAs are relevant at many different (or even all) locations where MNEs have production and/or sales, international institutional differences may also lead to typical location-bound FSAs. Figure 2 shows a framework that depicts the geography of climate-induced FSA development by combining, on the vertical axis, the location of the decision-making power for climate change and origin of FSA development – corporate headquarters, regional center, or national subsidiary – with, on the horizontal axis, the transferability of climate-induced FSAs. The framework shows to what extent it can be expected that an MNE becomes a global leader on tackling climate change. If an MNE for example initiates investments in non-location-bound FSAs in climate change mitigation from corporate headquarters (cell 2), there is more potential to have a lasting impact on the sustainability of the planet, compared to some local-bound initiatives in distant subsidiaries (cell 5).

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Figure 2 around here

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Applying the framework to MNEs' climate activities

Looking at MNE's climate activities, it seems that climate-related FSAs have a variety of sources, both geographically and institutionally. MNEs develop FSAs in response to climate-related CSAs, usually of their home country, but sometimes also of one of their host countries. It appears that country-specific climate policies have an effect on MNEs, but not always the desired effect of spurring innovation. In the US, for instance, many firms (particularly electric utilities) are participating in the Environmental Protection Agency's Climate Leaders program. However, currently this merely seems to affect initiatives to set voluntary emission reduction targets rather than FSA development. In the EU, the regional emissions trading scheme intends to form a stimulus for firms with energy-intensive activities to become engaged in climate-induced FSA development. Yet, it turns out that this scheme particularly influences electric utilities that by and large do not seem to respond by developing new FSAs either, but instead pass on the costs of their emission allowances to their customers (Hasselknippe & Røine, 2006; Morrison, 2006). It thus seems that country-specific climate change policies are not decisive for MNEs' decision to develop climate-induced FSAs.

However, what also becomes apparent is that particularly for the purpose of developing climate-friendly technologies, many MNEs seem to prefer to cooperate with external parties. This is in line with what was noted earlier, namely that a country's climate change policy does not determine MNE behavior in isolation; it also depends on the broader institutional framework (Makino et al., 2004). As a consequence, the origin of an FSA not always depends on the location of corporate headquarters or subsidiaries, but also on the location of the external actor – e.g. a government agency, university, or other firms – with which an MNE cooperates. For the car industry, for example, one potential reason to choose for cooperation is the fact that pressure to develop these technologies not only comes from the increased attention for climate change, but also from the recent surge in oil prices (Mackintosh, 2005a). To reduce the dependence on oil as primary fuel, car firms spend a lot of funds on the development of alternative fuel technologies. Controlling costs is therefore clearly a motive to partner with other firms. Another potential reason is the uncertainty about which technology will prevail. MNEs may seek to acquire knowledge from external parties or share knowledge with competitors to build support for their technology in the early stages of FSA development (cf. Spencer, 2003).

To develop new climate-induced FSAs several MNEs have ties with institutions such as universities and research institutes: Suncor funds a Clean Energy Laboratory of the University of British Colombia; ExxonMobil invests in the Global Climate and Energy Project of Stanford University; and ChevronTexaco is co-funding the Massachusetts Institute of Technology Joint Program on the Science and Policy for Global Climate Change. These particular firms focus on ties with universities and research institutes in their home country. However, several others are also looking across borders to affiliate with institutes in host countries. Australian-based Rio Tinto, for example, participates in research efforts of the US-based Electric Power Research Institute, while BP (together with Ford) has a partnership with Princeton University, called the Carbon Mitigation Initiative. This initiative has the aim 'to resolve fundamental scientific, environmental and technological issues key to public acceptance of carbon management strategies' (Ford, 2004). Technology for carbon capture and storage is one direction in which it bears out. It must be noted that for many of these cooperative efforts, the exact goal of linkages with universities and research institutes is not always openly delineated. While such ties can be strategic asset-seeking behavior and lead to knowledge creation and transfer, being associated with respectable institutes and showing climate change activity, cannot be ruled out as (additional) motives for such cooperation.

Cooperation with other firms often has a less ambiguous purpose; this more clearly aims at the development of new technologies. However, whether this also leads to climate-induced FSAs or shared capabilities instead and at what location(s), depends on the type of partner that is being sought. Many car and oil manufacturers work together with firms that own a specific technology. This usually includes small local niche players as well as large global competitors. For example, to develop biofuels both DaimlerChrysler and Volkswagen are cooperating with Choren industries; a German firm specialized in gasification technology for the production of energy from biomass. Likewise, Ford and DaimlerChrysler have both partnered with the Canadian niche player Ballard, which has developed the fuel cell technology, to further improve the fuel cell for use in cars. Two Canadian oil firms, Suncor and Petro-Canada, work with several local firms to develop an infrastructure for fuel cell vehicles and wind energy, respectively. Because the MNEs engaged in these partnerships are not only collaborators on these particular technologies, but also close competitors, it will be difficult to develop an FSA as it is inevitable that at least one competitor owns the same technology. There are more opportunities to create an FSA out of collaboration with firms from other industries, because both partners will use the ensuing technology quite differently in their downstream activities. Dow Chemical and General Motors, for example, work together on the development of fuel cells each for a different purpose.

If climate-related CSAs stimulate upstream FSA development in R&D that translates into new technological capabilities this would, on the face of it, lead to a position in the right-hand column of figure 2. It should be relatively easy to transfer a technology to other geographical locations, regardless of whether it originates from corporate headquarters, a regional center or a national subsidiary. A public policy-driven CSA such as a subsidy or tax break for the development of renewable energy technologies typically only has a function at the start of the lifecycle of an FSA, but once the technology becomes incorporated in a firm's products it can be redeployed to other locations (Helfat and Peteraf, 2003), thus creating a non-location-bound FSA. Climate-friendly technologies, for example related to hydrogen or fuel cells, are no longer of a tacit nature or tied to external parties such as local governments, and sourcing and production of these technologies can take place anywhere in the world (cf. Rugman & Verbeke, 2004). However, if the CSA continues to be of value further down the FSA lifecycle, transferability becomes more difficult. For example, for some specific technologies related to renewable energy, the location of production depends on a country's natural capital. Such geographic site specificity is crucial for hydroelectric and wind power, which require mountainous areas and sufficient wind speed respectively (Russo, 2003). Such an FSA cannot simply be redeployed, but needs to be recombined with a similar CSA in another geographical location (Helfat & Peteraf, 2003).

The same holds for the development of cars that run on biofuels based on so-called flex-fuel technology, which enables the use of ethanol (a biofuel) as well as gasoline. Car manufacturers including Ford, Fiat, Volkswagen, and General Motors, have first introduced this technology in their Brazilian subsidiaries (Johnson, 2006). Since the oil crises in the 1970s the Brazilian government has stimulated local sugar producers to invest in ethanol to reduce dependence on foreign oil, thereby creating a CSA in ethanol. Currently, an FSA in flex-fuel technology is still location-bound in foreign subsidiaries, because the natural resource necessary for this technology is readily available in this specific location. It could thus be positioned in cell 5 of figure 2. However, since President Bush announced intentions to also lower US's dependence on foreign oil in his 2006 State of the Union, interest in ethanol as a fuel has increased in the US as well (Simon, 2006b), which may form a CSA for the US in coming years. Therefore, for car firms flex-fuel technology may well become an FSA that moves from cell 5 to cell 3, spanning the whole American continent.

Nevertheless, most technologies for climate-induced FSAs are more likely to strongly depend on CSAs when they have further advanced in the FSA lifecycle and have moved downstream and reached the sales stage. ChevronTexaco (2004), for example, states that:

> We invest in a variety of renewable and alternative energy technologies and believe that those energy sources will be important in the overall mix of energy for the global economy in the future. But widespread application will depend on many factors, including the rate of technological development, market acceptance, and demonstration of economic viability.

A lack of transferability of FSAs is thus not necessarily the result of the tacitness of the knowledge on which they are based, but instead determined by the ability of MNEs to create market acceptance for new technologies to realize global distribution of sales (Cuervo-Cazurra et al., 2007; Rugman & Verbeke, 2004). In other words, although MNEs may have some influence on market acceptance through marketing campaigns, it largely depends on CSAs related to consumer responsiveness to climate-friendly products and services and availability of the necessary public infrastructure. For example, two main problems related to a successful launch of marketable fuel cell cars are the relatively high costs compared to conventional cars and the lack of a hydrogen infrastructure (Griffiths, 2005). High costs are likely to impede transferability of these cars to low-income countries, while the establishment of a hydrogen infrastructure is necessary in any country where an MNE wants to sell fuel cell cars.[5] Mackintosh (2005b) has formulated this problem of setting up a hydrogen infrastructure as follows:

> Drivers will not want hydrogen cars until there is a network of filling stations. But no company will invest in filling stations – and hydrogen production – until there is a critical mass of cars.

To find a solution for this problem it appears that MNEs will have to work with other private and public partners to create the necessary infrastructure to bring the fuel cell car to markets worldwide.

Activity in this direction can already be observed. Petro-Canada (2004) reports on a collaborative framework for a hydrogen infrastructure, as it is engaged with Ballard Power Systems and Methanex Corporation in a project for a fuel distribution network for hydrogen in Canada. Likewise, Air Products and Chemicals (2004) states that it 'is working with many public, private and governmental organizations to develop and promote the commercialization of hydrogen as a fuel in portable, stationary and transportation fuel markets and is leading the development of hydrogen infrastructure and fuel-handling technologies to enable the commercialization of hydrogen fuel cells.' However, since the political relations with the home government are generally much better than with host country governments (Baron, 1995), downstream FSAs for which sales rely on business-government cooperation are likely to stay bound to the home country or home region (cell 1 or cell 3).

In general, FSAs that rely on organizational capabilities to coordinate and control greenhouse gas emissions are even more problematic to transfer than climate-friendly technologies; not only does it build on particular CSAs, but such knowledge is often also of a tacit nature and organizationally embedded. This is most clearly seen in emissions trading. Currently, an FSA in emissions trading will be difficult to transfer to other affiliates within an MNE, due to the international fragmentation of support for the Kyoto Protocol. A global framework for emissions trading has not been established yet, but remains restricted to regional initiatives. The EU-ETS is the most prominent example and an FSA based on trading in this scheme is constrained to this region as it has not been linked to other schemes yet (cell 3). What is more, even though when new trading schemes are established, MNEs can build on their learning experience with the EU-ETS, this experience may be of limited value. It typically involves tacit, market-specific knowledge such as rules for allocating and trading allowances, which tend to differ considerably, even within the EU (Boemare & Quirion, 2002) and is by and large organizationally embedded. Being able to successfully trade emission allowances often depends on good communication between trading and production departments; an organizational capability that cannot be transferred easily. For these reasons, such organizational capabilities cannot be replicated but need to be recombined instead to fit local conditions (Helfat & Peteraf, 2003). When recombining is perceived as too cumbersome, however, MNEs may restrict trading to the location of their headquarters or particular subsidiaries (cell 1 or cell 5).

To illustrate, Barclays (2004) has been participating in the UK emissions trading scheme (a predecessor of the EU-ETS), but states that it cannot use this experience for the EU-ETS, because participation there is restricted to energy-intensive industries. For similar reasons, Unilever (2004) does not aim to develop a global strategy for emissions trading, but considers it the responsibility of local (or regional) management. Nevertheless, it is notable that some MNEs do seem to have the intention to create a non-location-bound FSA from emissions trading. Several MNEs, including Dow Chemical, Norsk Hydro, Repsol and Royal Dutch/Shell, have established a separate business unit at headquarters that is responsible for participation in emissions trading schemes for the MNE as a whole. These firms thus seem to have the intention to create a non-location-bound FSA in emissions trading (cell 2) and arguably do so because they see possibilities for arbitrage to exploit international differences in emissions trading schemes (cf. Ghemawat, 2003).

On the whole it appears that, with regard to the geography of climate-induced FSA development, MNEs are not positioned in the right-hand column of figure 2, as stated above, but more often in the left-hand column. There are still many institutional barriers for the transfer of technologies or organizational capabilities (Cuervo-Cazurra et al., 2007), because CSAs play a crucial role in the whole FSA lifecycle. Most climate-induced FSAs are therefore likely to stay location-bound, at least for the near future. Only when proper institutional frameworks, such as a hydrogen infrastructure or an emissions trading scheme, are set up on a global scale, will MNEs have the possibility to freely transfer their climate-induced FSAs. This particularly seems to be a problem for transfer of such FSAs to less-developed countries, where implementation of such institutions is not to be expected shortly.

Then again, international transfer of climate-induced FSAs to developing countries may get an impulse from another institutional arrangement of the Kyoto Protocol, that is, one of the Kyoto Mechanisms: the Clean Development Mechanism (CDM). CDM allows countries and firms to take advantage of reductions in emissions resulting from cross-border investments in developing countries (Grubb, Vrolijk & Brack, 1999). As Arquit Nederberger and Saner explain, CDM gives 'opportunities to technology providers to expand their market for state-of-the-art energy-efficient and climate-friendly technologies to developing countries, which, without CDM financing, may not be commercially viable in a developing country context' (2005: 12). In other words, a country's eligibility for CDM creates a new CSA to which MNEs can respond by replicating their FSAs from headquarters to this particular location (cell 2 of figure 2). One example of a firm that has already started to make use of the CDM is Spanish utility Endesa. Endesa (2006) is the largest privately owned electric utility in Latin America and is using CDM to transfer some its technologies to this region. Another firm interested in CDM is Nippon Steel (2005: 17):

> Nippon Steel would like to utilize the Kyoto Mechanisms to contribute to a reduction of CO_2 on a global scale through the transfer of its world's top energy conservation and environmental countermeasure technologies.

Conclusion: a research agenda

This paper has argued that a global sustainability issue such as climate change has the capacity to induce MNEs to develop FSAs that not only lead to environmental improvements as such, but may also affect firms' profitability, growth and survival. We have presented two frameworks to analyze the nature and geography of such FSA development. Subsequently, they have been applied to the case of climate change, using illustrative material from MNEs in several global industries. Climate change is an issue that affects a wide range of firms around the world, and that has implications beyond the 'pure' environmental dimensions, being linked to energy security and efficiency, and the fate of the planet more broadly. It has become a topic of societal, regulatory and corporate attention in recent years, and been brought to the fore as an 'inconvenient truth' that requires a concerted policy approach. Regardless of one's position in this debate, climate change provides a clear opportunity to consider how (green) FSAs (and FSA-CSA configurations) can develop and change, in a context where there is considerable attention for this topic, not only by environmentalists and policymakers, but also investors and major multinationals who have become rather active. At the same time, there is also considerable uncertainty and complexity in view of the diversity of contexts and policy responses, which means that FSAs developed in response to this 'moving target' will need constant rejuvenation. The climate change issue can thus give insight into dynamic capabilities, into how

MNEs may be able to learn at various fronts, from the issue itself as well as from the way in which it is being dealt with in a range of countries and industries. The two frameworks are meant to help identify and understand this, and reflect on possibilities and barriers, also in anticipating future developments and exercising leadership that reckons with strategic and societal concerns. Managers may want to include this in their consideration of risks and rewards of investing in FSAs, and policymakers to better understand how CSAs can be shaped and firms be (in)directely induced to invest in FSAs.

The application of the frameworks to the climate change issue showed that MNEs from different industries are developing different kinds of FSAs. Moreover, the types of organizational processes that are set in motion involve the development of green FSAs for some firms and the change of key FSAs for others. Still we can conclude that, as it currently stands, climate-induced FSA development may lead to a more radical, competence-destroying FSA reconfiguration for a few industries only; most MNEs stay relatively close to their current activities. A strategic reorientation is most likely to occur in the oil & gas and automotive industries but will not happen in the short run. A reason for this is that MNEs in these industries do not agree on the type of technology that will prevail in coming years, and most firms thus first invest in competence-enhancing transition technologies thereby still relying on existing FSA configurations.

It can be observed that climate change as a source of competitive advantage is likely to occur in high-salience industries such as the ones mentioned above, that is, those most confronted with the climate issue. In addition, continuous reflection on FSA development via internal investments (dynamic capabilities) also seems important for firms specialized in good or services that are instrumental to mitigating climate change impacts, or to anticipating, influencing or responding to public policy developments. For the remaining firms, climate change appears not to become a main source of profitability and growth, even though they may obtain legitimacy from acting visibly and credibly in the field of climate change. For them, there is no compelling reason to develop FSAs internally in managing climate change. Their route for addressing the issue is likely to go through external markets, for example, purchasing greener and productivity-enhancing technologies, adopting externally-developed tools and routines (such as on mitigation, emissions trading, measurement instruments) and 'outsourcing' certain activities to outsiders (who can, for example, take care of lobbying and stakeholder management). In this situation, FSAs may arise from 'internalization arbitrage' (Rugman & Verbeke, 2004; cf. Ghemawat, 2003) in the sense that MNEs obtain advantage from proximity and easy access to multiple external markets that offer such best available practices.

With regard to the geography of climate-induced development, it can be noted that many MNEs still focus on their home regions, for example, when looking for private or public partners to interact with for the development of new technologies. Region-bound FSA development seems likely in the case of emissions trading, because of the specific location of emissions trading schemes (on a large scale currently only operational in the EU); transferability will also depend on (policy) developments and related opportunities for using these FSAs in other regions. With regard to technological FSAs, a home-region focus may hinder transferability in the later sales stages, not so much in the early production stages of the FSA development chain.

It should be noted, however, that market responses to global climate change have emerged only recently, which means that our study of climate-induced FSA development could only be exploratory. Further research will be needed, also using other sources of information, when possible, to arrive at a more extensive set of data that allows for an examination of determinants of such FSA development, and possible performance implications. The issue of climate change provides a fertile area in which both existing International Business theories can be tested, and from which new theoretical insights into the dynamics of the interaction between MNEs and their national and international environment can be induced. Climate change particularly illustrates the exact workings of the interactions between FSAs and CSAs. What follows are more concrete research areas for the relationship between climate change and International Business.

Firstly, it will be interesting to assess whether transferability pays off throughout the Triad (North America, Europe, and Asia-Pacific), and if so, under what conditions. For example, will (bi)regional or (semi)'global', or highly internationalized and/or diversified MNEs fare better in this respect? It could be argued that firms internationalize partly to avoid stringent domestic regulation, which means that highly internationalized MNEs have the opportunity to do less about climate change in their host countries. MNEs located in regions of the Triad without stringent climate change regulations (e.g. North America and Asia-Pacific) would thus have the possibility to use their geographical spread to avoid making any changes to their existing FSA configurations. But geographical spread could also motivate MNEs to exploit climate-induced FSAs overseas. In addition, more international firms are also exposed to more diverse public pressures, suggesting that it might be more efficient to have one single 'leading edge' strategy towards climate change based on non-location-bound FSAs that encompasses different worldwide standards simultaneously, rather then a range of country-specific responses to each standard/regulation individually.

Secondly, a related question is what consequences foreign direct investment (FDI) has for emissions in developing countries. Fossil fuel-based energy use in developing countries such as China and India is on the rise, given their rapid industrialization. At the same time, MNEs are often highly active in these countries by means of FDI. Inward FDI in developing countries is generally believed to be associated with better (more efficient) technologies and production methods. This could lead to spillover effects to local firms, particularly because one of the Kyoto Mechanisms – the Clean Development Mechanism – potentially accelerates knowledge transfers to developing countries. It could thus be hypothesized that more inward FDI would reduce emissions. However, factor conditions and regulation could also have induced MNEs to locate their polluting activities in developing countries in order to exploit local circumstances rather then to improve them. In this case, FDI would be associated with higher emissions. It can thus be questioned whether inward FDI by MNEs increases or reduces emissions.

Thirdly, to what extent and under what circumstances do climate change measures affect corporate performance? Organizational activities induced by climate change could present unique FSAs, thus leading to competitive advantages and higher corporate performance, or less ambitiously, could result in energy efficiencies that reduce costs. But, on the other hand, measures to deal with climate change may in certain circumstances (depending on for example industry/location/firm-specific aspects) also impose additional costs, which may or may not be worthwhile investments that lead to high returns in the longer run. An additional question that could be asked is what the sustainability implications are of these firms' attempts to address this global problem. Will MNEs be able to contribute in a significant way to the solution for a changing climate?

The exploration of the climate change issue clearly raises a number of questions and several insights about MNE strategy and FSA-CSA configurations that may also be interesting for scholars that work on more 'mainstream' topics in international business. Climate change is an exemplary, perhaps even unique, issue to investigate how MNEs respond to socially relevant issues of sustainability, because it involves fossil fuel production and consumption. Many MNEs (particularly in energy-intensive industries) recognize the strategic impact and, accordingly, mention activities that seem to hint at initiatives to develop green FSAs or change key FSAs. The study of climate change thus forms a research 'frontier' that also clearly illustrates the complexities and societal relevance of International Business in the current epoch.

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Figures

		FSA Value Chain Orientation	
		Downstream FSA	Upstream FSA
FSA Reconfiguration Mechanism	FSA Evolution	1	2
	FSA Transformation	3	4
	FSA Substitution	5	6

Figure 1 The nature of FSA development

Origin of FSA Development		Transferability of FSAs	
		Location-bound FSA	Non-location-bound FSA
	Corporate Headquarters	1	2
	Regional Centers	3	4
	National Subsidiaries	5	6

Figure 2 The geography of FSA development

Notes

[1] We will, therefore, in the remainder of the paper use the terms FSA and capability interchangeably.

[2] Nevertheless, it must be noted that there may still be some emissions from the production of hydrogen, but this depends on the way it is produced.

[3] Although fuel cell and hybrid technology are quite different, investing in hybrid technology does give car firms the building blocks for developing the fuel cell vehicle (Anderson and Gardiner, 2006). Future hybrids decouple the mechanical connection between engine and wheels, which is also a requirement for the fuel cell vehicle (Ricardo Consulting Engineers, 2003).

[4] Although it must be noted that this partly depends on the size of the home country. MNEs from small economies are less likely to be affected by home-country regulations than firms from large economies such as the US (Rugman and Verbeke, 1998).

[5] The high costs of setting up a hydrogen infrastructure is an exemplary case of the difficulties that MNEs face in transferring FSAs, as it requires considerable linking investments to align an FSA with particular host-country CSAs (cf. Rugman and Verbeke, 2005).