Manufacturer decision-making factors and the role of environmental NGOs in the commercialization of non-halocarbon domestic refrigerators in Japan and Germany

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Abstract: As new actors in environmental policy, environmental NGOs have come under analysis in the fields of policy science and political science. This paper discusses how technological innovation, which plays a vital role in solving global environmental problems, is stimulated and deployed in the market by the activities of environmental NGOs. Specifically described are the decision-making factors of Japanese and German manufacturers in developing and commercializing ozone- and climate-friendly (hydrocarbon) refrigerator technology — a technological breakthrough currently sold on the world market brought about by Greenpeace Germany in collaboration with German manufacturers. The concept of "strategic bridging" is used to analyze, through a Japan-Germany comparison, the role of environmental NGOs in technological innovation and its deployment, and their influence on business and industry, whether direct or through the mobilization of public opinion. The Matsushita Refrigeration Company is highlighted for analysis in the Japanese context as the first company in Japan to make the commercialization of ozone- and climate-friendly domestic refrigerators an objective. Matsushita Refrigeration was also the main strategic target of Greenpeace Japan's refrigerator campaign.

Keywords: NGO, strategic bridging, ozone depletion, climate change, technological innovation, hydrocarbon refrigerators

1. Introduction

Under the Montreal Protocol on Substances that Deplete the Ozone Layer (Montreal Protocol) adopted in 1987, the parties to the protocol agreed upon concrete phase-out schedules of ozone depleting substances (ODSs) including chlorofluorocarbons (CFCs) and initiated implementations which would phase them out. Due to efforts under the protocol, the world consumption[1] of ODSs in developed countries had reduced by 99.2 percent in 2004 compared to the base year of 1986 in Ozone Depletion Potential (ODP) tons[2] (METI 2006: 6). This

staggering reduction accounts for the Montreal Protocol's reputation as an epoch-making example of international cooperation in the protection of the global environment.

The Montreal Protocol has not been an unqualified success, however. One criticism is that the Protocol created a disruptive interaction between ozone layer protection and climate change policies by encouraging the use of hydrofluorocarbons (HFCs) worldwide (Matsumoto 1999; Oberthür 2001). HFCs were developed by CFC producers to substitute CFCs and hydrochlorofluorocarbons (HCFCs). HFCs do not deplete the ozone layer, but are potent greenhouse gases.

Full-scale commercial production of HFCs began at the beginning of the 1990s, despite a number of reports submitted to the United Nations Environmental Programme (UNEP) conference as early as January 1988 which pointed out the high global warming potentials (GWPs)[3] of HFCs. The early reports were backed up later by two major reports: the First UNEP Scientific Assessment Panel report (1989) and the Intergovernmental Panel on Climate Change (IPCC)[4] First Assessment Report (1990). However, primarily because evidence showed that the ozone layer was depleting rapidly, encouragement for the use of HFCs as effective substitutes for CFCs continued largely unabated (Matsumoto 1999).

At the end of the 1980s, international environmental organizations such as Greenpeace and Friends of the Earth (FoE), who had been active in campaigning for the early phasing out of CFCs and other ODSs, started campaigning against the shift to the halocarbons[5] that were replacing them, namely, HFCs and HCFCs. The latter came under criticism as potent greenhouse gases which also deplete ozone. However, the halocarbon related industry and most of the major developed countries' governments insisted that there were no better alternatives to CFCs than HCFCs and HFCs — in particular in the refrigeration and rigid insulation sectors. It was argued that the only option would be to return to CFCs, if HFCs or HCFCs were prohibited.

This impasse came to a head over the use of domestic refrigerators, discussed in the case study of this paper. Prior to the 1990s, CFCs had been used (and are still used in some developing countries) in domestic refrigeration, both as a blowing agent for rigid foam insulation and as a refrigerant. By the early 1990s, refrigerator manufacturers in the U. S., Europe and Japan had decided upon HFC-134a[6] as a refrigerant. As a substitute blowing agent for insulation, the U. S. and Japan opted to use HCFC and Germany chose to cut the amount of CFC used in their foaming method by 50 percent. In each case, the manufacturers involved had invested heavily in commercializing refrigerators using HFC-134a. By contrast, Greenpeace focused its efforts on finding an alternative to halocarbon

refrigerator technology. These efforts reached fruition when Greenpeace Germany — in cooperation with a refrigerator manufacturer in the former East Germany and a municipal research institute in the former West Germany — brought about a technological breakthrough with the development of "Greenfreeze", a non-halocarbon refrigerator. The majority of Greenfreeze refrigerators use hydrocarbons such as isobutane or a mix of propane and butane as a refrigerant and cyclopentane as a blowing agent for insulation. Hydrocarbons do not harm the ozone layer, and the GWPs of hydrocarbons are negligible. Moreover, the energy efficiency of hydrocarbon refrigerators compares favorably with halocarbon-using refrigerators performing equally well or even better than refrigerators using HFC-134a, depending on the products being compared.[7]

By targeting the domestic refrigerator, an electrical appliance familiar to most homes in industrialized economies, Greenpeace Germany was able to stimulate a market demand for non-halocarbon domestic refrigerators which exerted a powerful influence on the German manufacturers' decision-making in terms of the commercialization of non-halocarbon refrigerator technology in Germany. Greenpeace's concern with regard to non-halocarbon domestic refrigerators was prompted by the likely burgeoning of the refrigerator market in developing countries: the transnational NGO was anxious to prevent halocarbon alternatives from dominating markets in developing countries at a time when consumer demand for domestic refrigerators could be expected to grow rapidly.

The above indicates how the international political context of HFC issues was a major underlying factor in Greenpeace's drive to deal with HFCs through technological innovation. Intergovernmental treaties in place at the time, including subsidiary mechanisms that dealt — or rather did not deal — with HFC issues, played a crucial role in prompting the NGO to act. HFCs had slipped through the net of international ozone and climate treaties for a long time before appearing on the agenda over the course of negotiations for the Kyoto Protocol, despite the fact that their high GWPs were recognized by the parties of the treaties. In the intergovernmental negotiations for the Montreal Protocol, for instance, the need to address the risks in using HFCs was raised a number of times, but was set aside as a problem for the climate treaties on the grounds that HFCs do not deplete ozone. Neither the 1985 Vienna Convention for the Protection of the Ozone Layer nor the Montreal Protocol include requirements relating to the global warming or environmental impacts of HFCs, and the UN Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol likewise failed to establish institutional links with ozone regimes already in place.[8] In 1998, parties to the UNFCCC and the Montreal Protocol adopted decisions (13/CP. 4 ;

X/ 16) recommending a joint workshop of experts from two panels — the IPCC and the UNEP Technology and Economic Assessment Panel (TEAP) — on three industrial gases listed by the Kyoto Protocol: HFCs, perfluorocarbons (PFCs) and sulphur hexafluoride (SF_6). Up until this time, the parties responsible for negotiating ozone and climate change policies had largely relied on unofficial communications between one another for dealing with HFCs. Even now, international coordination of policies and measures proposed by the E.U. and Switzerland within successive agendas of the Conferences of the Parties (COPs) of the UNFCCC remain at odds with the views of Japan, the U.S. and other countries which believe policies and measures on the three gases should be decided by individual governments. In accordance with a 2002 decision by COP 8 (12/CP. 8), IPCC and TEAP compiled an IPCC/TEAP Special Report in 2005 on the scientific and technical aspects and policies of the Kyoto Protocol's industrial gases such as HFCs and PFCs. It still remains unclear, however, whether there will be any agreement on remedial policies and measures on HFCs coordinated on the international level.

Two international policy factors may have been particularly influential in prompting Greenpeace to take up the halocarbon issue, and for this reason require special note here. The first of these, the Multilateral Fund for the Implementation of the Montreal Protocol (Multilateral Fund), is a financial mechanism under the Montreal Protocol, established to provide financial assistance and technological transfer to developing countries. The Fund has been influential in terms of determining the future direction of alternative technologies to ODSs in the developing world — encouraging the switch to HCFCs and HFCs in those countries. By the mid-1990s, the Fund's Executive Committee began to adopt fund criteria that took global warming into consideration. As a result, hydrocarbons and other substitutes with zero ODP and low GWPs attained about 75 percent (cumulative total up to March 1999) of approved projects in foam-blowing applications (IPCC 2001). However, the proportion of technology using HFCs as refrigerant substitutes remained high — 89 percent in residential and commercial uses — indicating that on the whole support for HFCs still accounted for a large market share (IPCC 2001; Oberthür 2001). UNEP's TEAP report — established to assess the alternative technologies available in terms of their possibilities for ODS reductions — was another major factor behind the promotion of HFCs under the Montreal Protocol. At the 1994 Meeting of the Parties, the Nordic countries and Germany, based on their experiences with hydrocarbon refrigerators in Europe, criticized the conclusion of the TEAP report, claiming that it offered a slanted assessment of non-halocarbon substitutes (Parson 2003: 227).

In the following sections, the roles of Greenpeace Japan and Greenpeace Germany in influencing the decision making factors of Japanese and German manufacturers are analyzed in relation to the potential roles environmental NGOs might play in the development and commercialization of innovative technologies to solve global environmental problems. Two aspects of Greenpeace Germany's campaign emerge in the following discussion: its efforts to win public support and lobby companies on the one hand, and the concept of "strategic bridging" on the other. The latter describes the creation of collaborative relationships bridging stakeholders from the same and/or different sectors for the duration of a limited shared agenda and proved an innovative and effective strategy in Greenpeace Germany's efforts to "green" the refrigerator industry through its breakthrough hydrocarbon refrigerator technology. For this reason, a detailed discussion of strategic bridging comprises the final section of this paper.

2. Overview of the Greenpeace non-halocarbon refrigerator campaign

2.1 Germany

In the late 1980s the German halocarbon manufacturer Hoechst AG accused Greenpeace Germany of "environmental blindness" that compromised international efforts to protect the ozone layer, condemning the NGO for its opposition to the use of CFCs as refrigerant substances. Hoechst AG argued that Greenpeace was endangering the lives of babies in developing countries by opposing the technology used to refrigerate, freeze and store essential vaccines and medicine. Compelled by this criticism to find alternative refrigeration technology, Greenpeace Germany launched an active search for non-halocarbon substitutes for refrigeration in 1989.[9] In the same period, CFC manufacturers were promoting the use of HFCs and HCFCs to the user refrigeration industry, arguing that in particular for applications of rigid insulation blowing agents and refrigerants, it was difficult to develop and deploy substances other than HCFCs and HFCs.

In the early 1990s, consumer appliance makers in Japan and the U.S. switched from CFC- to HCFC-use for refrigerator insulation blowing agents and from CFC- to HFC-use for refrigerant. Appliance makers in Germany continued to use CFC for insulation — reducing the amount used by half — while switching from CFC- to HFC-use for refrigerants. In 1992 Greenpeace Germany commissioned the development of a halocarbon-free refrigerator prototype from two parties: the first, the Dortmund Institute of Hygiene, a municipal research institute in Dortmund in the former West Germany, that had developed a hydrocarbon

refrigeration technology, and the second, DKK Scharfenstein (later privatized as Foron Domestic Appliances GmbH), a refrigerator manufacturer which made its own compressors in the former East Germany. Greenpeace Germany gave the name "Greenfreeze" to the resulting refrigeration technology, completed in July of that year, and launched a campaign, asking for advance orders on the condition that the refrigerator would be priced under 500 Deutschmarks and commercialized within a year. The campaign was a great success, bringing in about 70,000 advance orders. Treuehandanstalt, the agency responsible for privatizing previously state-run companies in the former East Germany, had already decided to dissolve DKK Scharfenstein, but public pressure created by Greenpeace Germany's campaign induced the agency to instead provide the company with funding to assist the commercialization of the new product.

In February 1993 major German manufacturers exhibited hydrocarbon refrigerator prototypes at the Domotechnica International Trade Fair for Household Appliances in Koln. The newly privatized Foron Domestic Appliances GmbH (hereafter Foron) initiated commercialization in March 1993, and was followed by Bosch-Siemens and other major manufacturers. Bosch asked Matsushita Refrigeration, which also makes compressors, to supply it with compressors for hydrocarbon refrigerant (interview with Bosch 2003). This order was completed in September 1994 and Matsushita began shipping compressors to Bosch from its Singapore plant.

In the autumn of 1993, Greenpeace's ongoing international efforts and public campaigning resulted in the approval of assistance for hydrocarbon blowing agent and refrigerants by a technical advisory group of the World Bank, the largest implementing agency of the Multilateral Fund of the Montreal Protocol. This helped to fund the deployment of hydrocarbon refrigerators in developing countries. In March of the following year, China's first hydrocarbon refrigerant production facility was completed after a collaboration facilitated by Greenpeace Germany and Greenpeace International between the German Agency for Technical Cooperation (hereafter GTZ), the German manufacturer Liebherr, and Haier, a major manufacturer of refrigerators in China (Stafford and Hartman 2001). In February 1995, Foron, Electrolux, Liebherr, and Bosch-Siemens formed joint ventures and commenced production of hydrocarbon refrigerators in China, closely followed by other manufacturers such as Kelon, China's largest manufacturer (Stafford and Hartman 2001). Greenpeace International and Greenpeace Germany also collaborated with the governments of Cuba and Germany, the United Nations Development Programme (UNDP) and the Global Environmental Facility (GEF),[10] to convert Cuba's refrigerator factory from using CFCs to hydrocarbons (Maté 2001). By mid-1996, hydrocarbon refrigerator

technology had gained an overwhelming 90 percent share of the German market. In November 1996 the European Commission revised the eco-label standards for consumer refrigerators and freezers, excluding refrigerators using HFC refrigerants. Efforts from national branches of Greenpeace in Britain, Denmark, the Netherlands, and other countries, working together to popularize Greenfreeze technology ensured Greenfreeze a market share in the entire European market, not just in Germany. Currently hydrocarbon refrigerators enjoy an approximately 15 percent share of the world market, holding approximately 52 percent of the European market and 19 percent of the Chinese market.[11]

2.2 Japan

In late April 1993 Greenpeace Japan imported hydrocarbon refrigerators from Germany and held a three-day exhibition in Tokyo. The exhibition was attended by some 600 visitors, the majority of whom represented companies, including major consumer appliance makers. At the time, the official view of the Japan Electrical Manufacturers' Association (JEMA) was that domestically produced refrigerators using HFC refrigerant and HCFC-blown insulation were safer and therefore better than the new hydrocarbon refrigerators: JEMA argued that the combustibility of hydrocarbons when combined with the cooling system most commonly used in Japanese refrigerators presented a fire-risk. Japanese refrigerators are equipped with automatic defrosters and a contingent cooling system that differs to systems used in Europe. This results in more electrical parts that can act as ignition points inside the refrigerator.

After the exhibit Greenpeace Japan launched a consumer postcard-writing campaign asking refrigerator manufacturers to commercialize hydrocarbon refrigerators. In addition, staff from Greenpeace Japan visited the Matsushita Refrigeration Research Institute to exchange views, and in other ways directly lobbied manufacturers. In April 1994 Matsushita Refrigeration commercialized Japan's first refrigerator using a hydrocarbon blowing agent for insulation. Again, as was the case in Germany, other manufacturers were quick to follow. Currently all refrigerator manufacturers in Japan use hydrocarbon-blown insulation. However, Matsushita Refrigeration and other manufacturers were still using HFC refrigerant at that time.

Greenpeace Japan revived its consumer campaign in March 1998 after the adoption of the Kyoto Protocol. Focusing on Matsushita Refrigeration, the Greenpeace campaign included signature-gathering, street campaigning, and direct action at trade exhibitions to pressure Matsushita Refrigeration to sell fully halocarbon-free refrigerators. In 1999 a representative from Greenpeace International and the executive director of Greenpeace U. K. visited Matsushita

Refrigeration and delivered a document which asked the company to specify when commercialization of one hundred percent halocarbon-free refrigerators would take place. The same document requested that commercialization should begin as soon as possible. Matsushita Electric Industrial Co. (MEI) set up a task unit in 1999 to determine how to respond to Greenpeace Japan's campaign and established a Hydrocarbon Technology Committee to make it possible to announce when hydrocarbon refrigerators would go on sale, contingent on assuring safety. A month after the task unit's formation, JEMA's Environment Committee approved the start of a voluntary safety standard formulation for refrigerators using hydrocarbon refrigerants. JEMA drew up voluntary standards in November 2001, followed in December by further voluntary standards on safety in distribution, repair, and disposal.

Matsushita Refrigeration announced in November 2001 that it would begin selling Japan's first non-halocarbon refrigerators on February 1, 2002. Rival manufacturer Hitachi made its announcement at the same time. Toshiba, despite initial resistance to using hydrocarbon refrigerant, pipped both companies to the post, launching its new fully halocarbon-free hydrocarbon refrigerator line one month earlier, in January 2002. Commercialization of halocarbon-free refrigerator technology had finally arrived in Japan: some nine years after its launch in Germany. By late December 2003, Matsushita had eliminated halocarbons from all its refrigerators of 300 liters or greater capacity (95 percent of all consumer refrigerators).

3. Decision-making factors of major consumer appliance manufacturers

3.1 Germany

In the early 1990s, German manufacturers were keen to directly shift from CFC using technology to a final workable solution that would be safe in terms of ozone depletion, instead of making the transition to another ozone depleting substance such as HCFC. For this reason, manufacturers continued to use largely reduced quantities of CFC for insulation blowing, while introducing the use of HFC for use as a refrigerant. This was viewed only as a temporary step, until a better solution could be found.

In 1993, two major German manufacturers, Bosch-Siemens and Liebherr switched to hydrocarbon cyclopentane for insulation blowing. Both Bosch-Siemens and Liebherr made the switch from using HFC refrigerant to hydrocarbon refrigerant only six months after switching from CFC to HFC use, in full knowledge that they would not be able to recover their capital investments in

HFC refrigerant equipment (interview with Bosch 2003). Over the course of interviews conducted by the author with representatives of Bosch and Liebherr in December 2003, both companies cited Greenpeace Germany's public campaign (its activities to galvanize public opinion either directly or through the media or other channels), market pressure, and commercialization by Foron as three of the major factors behind their decision to begin the switch to hydrocarbon refrigerator technology.

The widespread influence of Greenpeace Germany's awareness campaigns on manufacturer decision-making was emphasized repeatedly by representatives of Bosch, Liebherr and GTZ. Greenpeace Germany was credited in particular for its role in making refrigeration technology using hydrocarbons "socially acceptable" in Germany. In this respect, Greenpeace Germany's pro-active approach in bringing together two parties to engineer breakthrough hydrocarbon refrigerator technology had played an important role in the NGO's success at lobbying public opinion. A set of unique circumstances attending East-West German unification had converged fortuitously to advance the wide appeal of Greenpeace Germany's collaborative initiative. Treuehandanstalt, the aforementioned agency responsible for privatizing the previously state-owned industries of the former East Germany was loathed by East Germans for its role in closing down East German companies. This factor worked to Greenpeace Germany's advantage, when Treuehandanstalt targeted DKK Scharfenstein for dissolution (interview with Lohbeck, 2003). Greenpeace Germany had struck lucky in its choice of partner. Not only did DKK Scharfenstein already possess the infrastructure to manufacture its own compressors — this giving the company the means to experiment with alternative refrigerants, in comparison with other German manufacturers who needed to outsource them — but DKK Scharfenstein's vulnerability made it desperate for a new product to save it from being dissolved. These factors, combined with Treuehandanstalt's negative public image, helped consolidate the success of Greenpeace Germany's campaign. The agency attracted severe criticism from the media: its attempt to stop a Greenpeace Germany and DKK Scharfenstein joint press conference in 1992 presenting the world's first non-halocarbon refrigerator to the public earning it special censure. Treuehandanstalt was obliged to back down — cancelling DKK Scharfenstein's dissolution, promising not to dismiss its workforce, and furthermore lending the company 5 million Deutschmarks to assist in the commercialization of the new product (interview with Lohbeck 2003; Stafford and Hartman 2001).

Stafford and Hartman emphasize that the important driver for the promotion of Greenfreeze in the early stage of its development was Greenpeace Germany's reputation. This won the NGO enough support from consumers to put pressure

on German refrigerator manufacturers and Treuehandanstalt. Interviews with representatives of Bosch and Liebherr reveal that Greenpeace Germany's high public standing gave it a great deal of leverage over manufacturer decision making, in particular when it focused criticism on specific companies, such as Bosch, in campaigns covered extensively by the media. Greenpeace's attentions were not always coercive: Liebherr was able to gain a large market share after positive media coverage when it adopted Greenfreeze technology.

3.2 Japan

The release of Greenfreeze technology on the German market in 1993 by refrigerator manufacturers in the former West Germany prompted major Japanese manufacturers to begin research and development (R&D) on hydrocarbon refrigerators. Matsushita Refrigeration had already switched from CFC-11 to HCFC-141b for insulation blowing, but Greenfreeze's commercialization decisively influenced the company's decision to make a second switch in blowing agent soon after. Matsushita Refrigeration started R&D of hydrocarbon refrigerants in April 1993, shortly after Greenfreeze's commercialization in Germany. Matsushita Refrigeration was not alone in seizing the initiative. As aforementioned, Toshiba managed to trump Matsushita Refrigeration in 2002, releasing its own fully hydrocarbon refrigerators days ahead of Matsushita, having set up an advance development unit to identify the hurdles of hydrocarbon refrigerants and obtained patents in 1993 and 1994.[12]

Japanese consumer appliance makers had considered hydrocarbon refrigeration as an option over four separate time periods: first, around the adoption of the Montreal Protocol in 1987;[13] second, around the commercialization of Greenfreeze in Germany and Greenpeace Japan's subsequent exhibition of Greenfreeze technology in Japan in 1993; third, at the time of the adoption of the Kyoto Protocol in 1997; and fourth, the period following Matsushita Refrigeration's decision to commence production of hydrocarbon refrigerators, when the company embarked upon a specific schedule for commercialization as the result of Greenpeace Japan's campaigning. Among these factors, Greenfreeze's commercialization and the adoption of the Kyoto Protocol were noted as particularly important by Matsushita Refrigeration. Representatives of the company admitted that Greenpeace Japan's campaign had influenced the company in two key ways: first, boosting Matsushita Refrigeration's in-house discussions on eliminating halocarbon use, and second, encouraging the company in its decision to commercialize eight years earlier than planned.

In May 2003, results were published of a study commissioned by Japan's Patent Agency on the number of patent applications into technologies including

hydrocarbons and other natural refrigerants. The results noted that following initial increases in the number of patent applications for hydrocarbon technologies first seen in the early 1990s, the Kyoto Protocol was probably the determining factor in the soaring number of patent applications for hydrocarbon technologies submitted in 1998 (Patent Agency 2003: 4–5). One explanation for the Patent Agency's findings is that both German commercialization and the Kyoto Protocol directly influenced the development of hydrocarbon substitutes. Interviewees at Matsushita Refrigeration noted that if HFCs had not been listed in the Kyoto Protocol, Matsushita Refrigeration would probably have continued using HFC-134a in the same way as CFC-12 was used — focusing their "green" efforts on the recovery of halocarbons.

Other decision-making factors pinpointed in interviews with representatives from the Japanese refrigerator industry included (1) trends in the European market, (2) trends in standards by the International Electrotechnical Commission, (3) observations of market trends, in which hydrocarbon refrigerant use in consumer refrigerators was becoming mainstream worldwide, with the exception of the U. S. market, (4) market predictions for developing countries (in particular, in China), (5) Greenpeace Japan's argument that HFC recovery was an unrealistic option in developing countries (this argument proved particularly persuasive to Matsushita Refrigeration, who up until that point were still discussing whether problems with HFC use could be solved by recovery and destruction), and (6) emerging solutions to technical problems in hydrocarbon use related to system differences, safety, cost and efficiency.[14] Furthermore, although not mentioned explicitly in the interviews with Japanese manufacturers, the fact that HFC-related equipment would soon be amortized may well have been an additional factor in the Japanese context. In this regard, the German manufacturer Bosch observed that amortization had not been an issue in its decision making processes in Germany.

To summarize, in Japan it was only after two conditions had arisen — the Kyoto Protocol and commercialization by German manufacturers — that an NGO was able to directly influence corporate decision-making on the commercialization of hydrocarbon refrigerator technology. In the German context, major appliance manufacturers embarked on commercialization in the wake of Greenfreeze development under the lead of Greenpeace Germany even before the possibility or likelihood of international HFC controls arose. In Germany, Greenpeace was able to change the behavior of companies, consumers, and the government, despite the absence of either legal or economic incentives. This was not the case in Japan.

4. NGOs and "strategic bridging" innovation: a Germany and Japan comparison

4.1 Strategic bridging

Greenpeace is well known for campaign tactics which include non-violent direct action, political lobbying and public awareness campaigning. Over the course of the Greenfreeze campaign, Greenpeace tried something new in addition to its more conventional campaign tactics. By collaborating with new actors both domestically and internationally, and by forming bridges between those actors, Greenpeace changed market trends in Germany and Northern Europe and created new linkages among a number of companies (including German manufacturers and Calor Gas Limited, the U.K.'s largest LPG supplier), a municipal research institute (the Dortmund Institute of Hygiene), a government agency (GTZ), and UN agencies.

The most appropriate concept for understanding these linkages is "strategic bridging" — a term first introduced by Westley and Vredenburg in 1991 in the context of analyzing environmental NGO and business collaborations (Stafford et al. 2000).[15] Sharma defines strategic bridging as being "characterized by the presence of a third party as a stakeholder, which is separate and distinct in terms of resources and personnel from the 'island' organizations it serves to link ... Unlike mediators, bridgers enter collaborative negotiations to further their own ends as well as to serve as links among domain stakeholders" (Sharma et al. 1994: 461). More recently, Stafford et al. have cited Brown (1991)'s definition of strategic bridging as cultivating "a 'vision' toward solving problems in contexts characterized by high stakeholder interdependence and turbulence and identifies bridging opportunities that may advance that vision" (2000: 125).

In a case study of the Greenpeace-Foron alliance over the development of Greenfreeze technology in Germany, Stafford et al. argue that expertise in activism gave Greenpeace Germany the sociopolitical power which led to the effectiveness of its bridging (2000: 132). The bridging's success can be partly measured in terms of the market and public pressures it galvanized which acted upon other refrigerator manufacturers: first in Germany and, later, to a lesser extent, in Japan. The following section offers a detailed discussion of the actors involved in strategic bridging carried out by Greenpeace Germany and assesses the effect of strategic bridging on the Greenfreeze campaign. The section ends with a short analysis of a number of factors which contributed to differences in the effectiveness of strategic bridging activities carried out by Greenpeace Germany and Greenpeace Japan.

4.2 NGOs, strategic bridging and social context

Greenpeace, one of the biggest international environmental NGOs, currently with some 2.7 million members worldwide, conducts campaigns all over the world through its national offices. Greenpeace's Greenfreeze campaign, for example, involved not only European offices, but also offices in Japan, Tunisia and Argentina, as well as in other countries. Offices share the same goals and in many cases the same strategies and tactics, and international campaign coordinators coordinate the worldwide campaign to achieve Greenpeace's goals, by working through project coordinators, and regional and national campaigners. As Paul Wapner explains (1994: 48–50), campaigners present the frontline of Greenpeace's work, devising the activities to be carried out, and identifying the most effective ways to communicate with people and change environmentally destructive practices within their given national or regional context: "Campaigners focus on the [targeted industries] in their respective countries, taking into account the governmental cultural, and industrial attributes of each country to address the problem.... They take the general intentions of projects and overall campaigns and translate them into concrete actions that are tailored for specific geographical and political contexts." (Ibid: 49–50).

This strategy of tailoring actions to local contexts could be seen over the course of the Greenfreeze campaign. Although Greenpeace Japan implemented many of the strategies and tactics used by Greenpeace Germany, its overall strategy placed far less emphasis on "strategic bridging". This was partly because Greenpeace Japan lacked the capacity to practice "strategic bridging" as an organization but also because of the social context in which it was working. To understand the underlying reasons for these differences it is important to look both at the differences in the social and political influence of Greenpeace in Germany and Japan and the nature of relationships between businesses and environmental NGOs in these two very different social and cultural contexts.

In Germany, Greenpeace enjoyed considerable popularity from the late 1980s into the early 1990s; Greenpeace Germany's post-reunification membership of 640,000 supporters was in many ways a reflection of the explosion of public interest in environmental organizations that emerged in response to transboundary environmental problems affecting Germany, such as acid rain, the Chernobyl meltdown in 1986, and the ozone depletion issue. German citizens' high awareness of the environment[16] translated into rapidly increasing support for the German Green Party at the national level, and support for Greenpeace's radical and confrontational tactics at the local, regional and international levels. All these factors gave Greenpeace Germany powerful leverage with which to conduct its campaign.

In Japan, on the other hand, the situation for environmental activists is complex. Schreurs' analysis of NGO activity in Japan in the early 2000s has shown that support for environmental NGOs in Japan remains poor and acceptance-levels from governmental and industrial actors mixed (2002: 219). This leads to immense differences in the size of membership and resources of NGO communities in Japan and Germany.[17] Public acceptance of Greenpeace is particularly low in Japan, moreover: Greenpeace's ongoing international anti-whaling campaign has been deeply unpopular with the Japanese public and media coverage of Greenpeace's more confrontational actions overseas and the arrests which sometimes follow them have likewise given Greenpeace a negative image in Japan. In the transboundary Greenfreeze campaign, as Stafford and Hartman have pointed out, "A radical image could weaken a group's bridging capabilities within some cultures (e. g., Japan), but enhance it in others (e. g., Europe)" (2001: 126).

The results of two opinion polls show a clear difference in public perceptions of international NGOs in Japan and Europe. A report of a public opinion poll conducted in August 2005 on attitudes to Non-Profit Organizations (NPOs) issued by the Japanese Cabinet Office noted that only 30.6 percent of respondents said that NPOs had a trustworthy image — 15.7 percent saying that they believed NPOs were untrustworthy. In stark contrast, the results of a 2002 survey commissioned by the World Wide Fund for Nature (WWF) to determine the trust that people in Western countries place in NGOs, companies, governments and the media demonstrated the great trust that Europeans invest in NGOs. Europeans were found to place trust in these four institutions in the descending order of NGOs, companies, governments, and the media. In a category which assessed trust in brands, Americans gave the three top places to Microsoft, Coca-Cola, and McDonald's, while Europeans awarded them to Amnesty International, WWF, and Greenpeace. The percentage of people who would not purchase brands boycotted by NGOs was 32 percent in the U.S. and 49 percent in Europe (Edelman Public Relations 2002). Although a statistical comparison of these two surveys is not possible — they were, after all, conducted at different times and by different methods — their results suggest strongly that the level of trust enjoyed by NGOs in Europe is much higher than in Japan. The following section gives some indication as to how much different degrees of social trust in NGOs may have affected the effectiveness of Greenpeace's Greenfreeze campaign strategies and tactics in the German and Japanese contexts respectively.

4.3 Greenpeace, strategic bridging and the Greenfreeze campaign

Greenpeace Germany's most important strategic bridging linked the Dortmund

Institute of Hygiene with DKK Scharfenstein, as discussed in Section 2.1. In this case, Greenpeace facilitated collaboration between an institute, which had already succeeded in developing hydrocarbon refrigeration technology, but did not have the capacity to develop that technology as a product, and a company capable of producing compressors for refrigerators that was facing the crisis of dissolution. The combination was fortuitous: after encouragement from Greenpeace Germany, DKK Scharfenstein fastened its last hopes for survival on marketing the Dortmund Institute's new technology as the world's first halocarbon free domestic refrigerators, an arrangement that clearly worked in the interests of all three parties with Greenpeace Germany acting as a bridge between the three. This collaborative relationship yielded a large amount of bridging expertise and technical knowledge to Greenpeace Germany. This in turn was used to carry out further bridging amongst additional stakeholders afterwards, when the time came to bring Greenfreeze technology to the world market.

Of these, bridging initiatives with GTZ and the LPG supplier Calor were particularly important. Inspired by Greenfreeze's development and marketing, GTZ had created a department called Proklima in early 1996 to promote hydrocarbon technology in developing countries. Fundamentally an organization involved in overseas development aid, GTZ was engaged in efforts to improve its environmental profile at the time, as noted by Sicars, a representative of GTZ, speaking in interviews with the author which took place in 2003. Joining up with the German government, GTZ urged the Multilateral Fund's Executive Committee to adopt a new policy of financial assistance for hydrocarbon technology which would help disseminate hydrocarbon technology in developing countries. Next, in collaboration with Greenpeace Germany and German manufacturers, GTZ implemented the Multilateral Fund's bilateral aid framework to fund the transfer of Greenfreeze technology to developing countries. GTZ participated furthermore in meetings of the IPCC, TEAP, and other organizations, where it offered specialized knowledge on halocarbon and hydrocarbon technologies.

By contrast, strategic bridging with Calor was instrumental in building up Greenfreeze's market share in Europe. In 1994, Calor was inspired by Greenfreeze to develop hydrocarbon refrigerants for commercial use and to enter the refrigerant market (Stafford and Hartman 2001). In cooperation with Greenpeace Germany, Greenpeace U.K., Greenpeace International, and other Greenpeace national offices, Calor helped deploy hydrocarbon refrigerant technologies in Europe. Greenpeace and Calor worked together with manufacturers of commercial refrigeration equipment and industrial users of commercial refrigeration equipment — the latter including Iceland, a frozen food supermarket

chain located in the U.K. (Stafford and Hartman 2001). Greenpeace Germany and Greenpeace International, in collaboration with Calor, held a series of seminars on non-halocarbon alternatives as a side-event during intergovernmental negotiations on climate change, and presented evidence of commercialization of non-halocarbon alternatives to governments, media and user industries in a number of different sectors — in each case providing essential knowledge and information with regard to the alternative technologies offered by the non-halocarbon refrigeration industry. Calor personnel supplied knowledge as hydrocarbon experts to a number of standards committees, the scientific working group of the IPCC and a variety of organizations authoring regulations in various countries. This expertise was utilized by Greenpeace in arguments with industry over the flammability and energy efficiency of hydrocarbons and afforded Greenpeace vital "commercial legitimacy", as noted by Stafford and Hartman (2001). Calor's laudable contribution to the promotion of Greenfreeze was presumably measured less in terms of an increased share in potential profit from business in hydrocarbon refrigerant technology, and more in terms of the improvements to Calor's environmental profile which came about over the course of Calor's involvement in promoting Greenfreeze technology.[18]

Further acts of strategic bridging carried out by Greenpeace Germany include the mediations between German and Chinese refrigerator manufacturers which facilitated collaboration in the production and marketing of hydrocarbon refrigerators in China, described in Section 2.1. In the Chinese case, as in many of the cases discussed in this section, the transboundary collaborative relationships among different stakeholders "bridged" by Greenpeace was enhanced and expanded by the participation of the various Greenpeace offices in different countries.

It is important to note that in all the cases discussed in this paper, Greenpeace Germany's relationship with other organizations was one of short-term collaboration with a single common objective or "solutions" agenda (Stafford and Hartman 2001: 126) in mind. One important difference between strategic bridging and other forms of collaboration is that the bridge must retain "back-home" commitment from its constituents and remain at all times an independent entity with its own agenda (Westley and Vredenburg 1991: 65; Sharma et al. 1994: 461). This results in a contradiction in the way in which a given company and environmental NGO entering upon a collaboration perceive their relationship: while for the company, the NGO will for a certain length of time secure the company's competitive edge over other companies, for the environmental NGO, an exclusive partnership is not in its interest (Stafford and Hartman 2001: 126). In fact, on the day in March 1993 that Foron launched Greenfreeze

commercialization, Greenpeace Germany held a press conference announcing that it was parting ways with Foron, thereby indicating clearly that it would have nothing to do with the commercial profit of a certain company. Subsequently Foron was bested in competition by a company in the former West Germany and bought out by another European manufacturer. In the second half of 1993 after Greenfreeze commercialization, Bosch-Siemens replaced Greenpeace Germany as a strong leader in promoting hydrocarbon refrigerators. In short, Greenpeace Germany's efforts were not about promoting the product of a certain company, but rather, the direction that technology — in this case, non-halocarbon technology which demonstrated that HFCs were not needed — should take.

By contrast, how did Greenpeace's strategic bridging work in Japan? Particularly in the early stages of the Greenfreeze campaign, Greenpeace Japan diplomatically took a reserved approach, avoiding media attention-catching confrontational actions that might have deterred manufacturers from looking at the technological and commercial potentiality of hydrocarbon technologies in Japan and focusing efforts instead on relaying information and data regarding Greenfreeze between Germany and Japan. This approach was successful in the sense that in 1997 Matsushita Electric Industry invited Greenpeace Japan's staff campaigner to its annual training seminar for engineers as the keynote speaker on climate change issues, at a time when the attitude of the rest of the refrigerator industry remained skeptical about Greenpeace's role as a transnational environmental NGO.

Greenpeace Japan's efforts at strategic bridging lay primarily in bringing together Calor and related Japanese companies (Stafford et al. 2001). However, this mainly consisted of providing information of potential useful contacts in Japan to Calor, and pooling information from Calor on world trends in hydrocarbon technology, service manuals and other information sources with Japanese consumer appliance makers. With Greenpeace Japan taking a backseat, reasoning throughout that alliances between Calor and Japanese manufacturers would proceed more smoothly without its involvement,[19] Calor took it upon itself to build up a cooperative relationship with a Japanese LPG supply company. In response to interview questions about the knowledge that Calor and its Japanese partner brought, Matsushita Refrigeration said, "It was beneficial in determining our orientation and making preparations."

Greenpeace impacted on Matsushita Refrigeration in a number of ways: directly, through its consumer campaigns, a number of non-violent direct actions after 1998, and the provision of knowledge and information, but also indirectly, during the process of negotiations for the Kyoto Protocol, where Greenpeace held technical workshops reporting on hydrocarbon technologies and what was

happening in regard to them in the European — and in particular, German — market. However, little formation of the kind of strategic bridging seen in Europe between Greenpeace and companies or manufacturers could be seen in Japan. The Japanese companies concerned were influenced to a large extent by the collaborative relationships resulting from strategic bridging by Greenpeace Germany in Europe, but they did not participate in expanding them. In Japan, as noted, a Japanese LPG supplier company played a role in bridging between Calor and Japanese manufacturers, but it is hard to ascertain whether the relationships created were collaborative, in spite of a certain level of knowledge and information transfer. It is likely that the development or commercialization of non-halocarbon alternatives by the Japanese refrigeration manufacturers other than Matsushita Refrigeration and industry in other sectors happened as the result of responses to the Kyoto Protocol on the part of various manufacturers, trends in the European market and Matsushita Refrigeration's market leading decisions.

5. Conclusion

Greenpeace Germany had proved the technological and commercial availability of non-halocarbon alternatives through collaborations with German refrigerator manufacturers and a municipal research institute. In Germany, in particular, but also in the rest of Europe, Greenpeace was able to influence the behavior of industry, consumers and the government in the absence of incentives such as direct regulatory or economic policies or measures. What made Greenpeace's activities effective was continuous expansion of the collaborative relationships among stakeholders in different sectors built through Greenpeace's strategic bridging, and strategic bridging by key stakeholders such as Calor and GTZ, who were part of the already existing collaborative relationship.

Although Greenpeace Germany and Japan are part of the same international NGO, differences can be observed in this case study in terms of their influence on the decision making of manufacturers through the formation of a collaborative relationship among stakeholders. Evidence would imply that the effectiveness of strategic bridging by NGOs is greatly dependent on the bridger's social and political leverage in the society in which it operates.

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Notes

[1] Consumption is defined as "(production + import) — export" in the Montreal Protocol.

[2] A relative index indicating the extent to which a chemical product may cause ozone depletion. The reference level of 1 defines the potential of CFC-11 and CFC-12 to cause ozone depletion. "ODP tons" is the number of tons of a substance multiplied by its ozone depletion potential (Andersen and Sarma 2002: 480–481)

[3] "GWPs are indices comparing the climate impact of a pulse emission of a greenhouse gas relative to that of emitting the same amount of CO_2, integrated over a fixed time horizon" (IPCC 2005: 5)

[4] The IPCC is the institution, established in 1988 by governments through UNEP and WMO to provide an authoritative assessment of the state of knowledge concerning climate change.

[5] A compound derived from methane (CH_4) and ethane (C_2H_6), in which one or several of the hydrogen atoms are substituted with chlorine (Cl), fluorine (F) and/or bromine (Br). CFCs, HCFCs and HFCs are examples of halocarbons (Andersen and Sarma 2002: 479). In this paper, alternatives to ODSs which do not use halocarbons are called "non-halocarbons".

[6] HFC-134a is the most popularly used HFC, used in automobile air-conditioners, domestic refrigerators and commercial refrigeration.

[7] The IPCC/TEAP Special Report (2005: 48) notes isobutane and HFC-134a are the major alternative refrigerants replacing CFC-12 in new domestic refrigeration equipment. The two refrigerants are comparable in terms of their mass production capability for safe, reliable, efficient and economic use.

[8] The only such provision is for covering "greenhouse gases not controlled by the Montreal Protocol" in Article 4 of the UNFCCC, to avoid overlap with the 1987 Montreal Protocol.

[9] This sequence of events was described by Lohbeck, a Greenpeace Germany campaigner, in interview with the author in December 2003. The interview was conducted as part of a wider survey of environmental NGOs' influences over the decision making of manufacturers in commercializing non-halocarbon refrigerators. In all, 22 primary actors in Germany and Japan were interviewed: five present and former Matsushita Refrigeration employees (including the Directors and General Manager of Matsushita's Refrigeration Research Laboratory) between October 10, 2002 and July 2, 2003; one former employee at Matsushita Electric Industrial Co. on October 16, 2002; one present and one former employee at the Japan Electrical Manufacturers' Association on June 13, 2003; the former Division Director and the former chairman (presently JEMA Managing Director) of JEMA's Environmental Committee on October 10, 2002; the Director of the Business Department at a Japanese LPG supplier on November 11, 2002; the former director of the Ozone Layer Protection Office at the former Ministry of International Trade and Industry on February 7, 2003; four engineers working at Toshiba on July 2, 2003; one person from the German Agency for Technical Cooperation (GTZ) on December 12, 2003; one present and two former employees of Bosch on December 16, 2003; one Liebherr employee on December 4, 2003; and finally, Lohbeck from Greenpeace Germany, on December 15, 2003 ("Present" in this context indicates the positions held by interviewees at the time of interview).

[10] The GEF is an independent financial organization that provides grants to developing countries for projects that benefit the global environment and promote sustainable livelihoods in local communities (URL: http://www.gefweb.org/).

[11] Figures extrapolated from documents received during interviews with representatives of Matsushita Refrigeration in October 2002 in conjunction with statistics given on the website of the Japan Electrical Manufacturers' Association, accessed November 10, 2006: http: //www.jema-net.or.jp/

[12] Representatives of Toshiba interviewed in 2003 noted that the company had obtained patents from general research on HFCs, HCFCs, and other substances, and on hydrocarbons in 1987. Later, under pressure from the Montreal Protocol, Toshiba prioritized switching to substances with lower ozone depletion potentials (ODPs), with GWPs perceived as the next problem to be dealt with. They imported a Foron refrigerator and analyzed its workings. Toshiba then proceeded with basic non-halocarbon development, and in 1996 and 1997 engineers conducted research on what to do about the difference between direct and indirect cooling in the refrigeration cycle.

[13] 1986 was the year when research and development for replacing CFCs started in Japan. U. S. patent applications in the same year focused on technologies for the halocarbon substitutes and natural refrigerants (Patent Agency 2003: 102).

[14] For example, the isobutane refrigeration cycle turned out to enjoy a higher efficiency than halocarbon using alternatives (theoretical efficiency is +5%) (Toshiba interview: July 2, 2003).

[15] The concept of strategic building has been discussed and elaborated by Brown (1991), Savage et al. (1991), Stafford et al. (2000), Sharma et al. (1994) and Sasaki (2001), among others.

[16] "A June 1990 poll reported in the *Frankfurter Allgemeine Zeitung* found that at the end of November 1990, just prior to the first elections for a united Germany, 51 percent of those surveyed said that environmental degradation was the political problem that concerned them most. This was just below the 54 percent who answered that their biggest concern was the danger of war in the Middle East." (Schreurs 2002: 155).

[17] The largest and oldest internationally oriented group with a predominately environmental focus in Japan is WWF Japan. In 2000, it had a membership of 50,000, up from 37,370 in 1992. WWF Germany had 180,000 members at that time. Greenpeace Japan's membership of 5,000 in 1998 compared with a membership of 250,000 in Germany in the same year. FoE Japan had a membership of 380 in the late 1990s; in the same period, FoE Germany's membership totaled 240,000 (Schreurs 2002: 210).

The financial resources held by these NGOs, at the end of the 1990s differed widely. WWF USA enjoyed a budget of over $110 million. By contrast, WWF Japan, the richest predominantly environmental NGO in Japan had a budget of around $8.4 million. FoE Japan struggled in the same period on around $480,000. Greenpeace Japan's budget of $1.5 million may seem large in comparison, but it has been heavily subsidized by Greenpeace International for many years. In comparison, Greenpeace Germany's budget — comprised entirely of private contributions and donations — was approximately $32 million in the same period (Schreurs 2002: 21).

[18] This assessment of Calor's contribution and the benefits to Calor of participation in the promotion of Greenfreeze technology was given by Sicars, speaking personally, rather than as the representative of the German Agency for Technical Cooperation where he was working at the time of interview in 2003.

[19] The information in this section is based on the author's own experiences working for Greenpeace Japan as a campaigner throughout the Greenfreeze campaign between 1991 and 1997.

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