Cool Carbon

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Abstract

The rationale for a Public-Private Partnership between Bosch und Siemens Hausgeräte (BSH) and GTZ-Proklima is outlined, comprising a new Kyoto Protocol Clean Development Mechanism (CDM) Methodology and a Programme of Activities CDM Project to replace old household refrigerators. It is suggested that CDM projects in general can extend global emissions trading and support the costs of accelerating the diffusion of energy efficient appliances. CDM projects undertaken by or via utility companies in particular have the potential to lead to a new generation of Demand-side Management. The Partnership implements a PoA project in Brazil and the results obtained will allow to upscale such CDM projects for household refrigerators worldwide.

The Kyoto Protocol and Household Appliances

Using less energy does not necessarily have to mean sacrifice on the part of the consumer. Demand-side Management (DSM), which can generate "negawatts" in lieu of generation capacity to meet the demand for energy, can be encouraged by and has been successful under some regulatory regimes [[1] p.12]. In some circumstances, this requires habit changes on the part of businesses and individuals – such as using appliances during off-peak hours, or changing shifts for energy-intensive operations so that demand does not outstrip supply. For instance, such DSM measures are currently used out of necessity by South African Eskom to reduce the daily power outages due to rapid growth in energy demand having overtaken supply. Another example involving more structured management is Stadtwerke Hannover and Freiburg's use of DSM in their Integrated Resource Planning as a long-range option for the past 10 years. Rather than ask customers to change habits, they have been carefully crafting subsidies for efficient refrigerators, light bulbs, insulation and other energy savers that allow consumers to enjoy similar or even better services while consuming less energy. This leads to happier customers, lower energy bills, more easily managed power demands and reduced impacts on the environment. In other words, Demand Side Management can bring significant benefits to all stakeholders.

The Kyoto Protocol and carbon markets, more broadly, have the potential to lead to a new wave of utility DSM and other end-use efficiency activities. The first critical mass of residential Clean Development Mechanism (CDM) projects are those that substitute Compact Fluorescent Light bulbs (CFLs) for incandescent light bulbs, typically providing the same lumen output using 75% less electricity. In Mexico, India and Senegal the documents for registering CDM projects, with around 35 million light bulbs, have already requested registration from the Kyoto Protocol authority, the Clean Development Mechanism Executive Board. The idea is simple: end-users are provided with efficient CFL bulbs free of charge (or at a reduced price) in exchange for the inefficient incandescent bulbs. The programs are paid for by revenues from sales of carbon credits, called "certified emission reductions" or CERs (and from sales of CFLs, depending on the design of the program). Thus the entity that implements the program covers the bulk of the up-front capital cost of the more expensive CFLs and is paid back over the lifetime of the CFLs, as CERs are generated and sold, eliminating the up-front capital cost barrier to the end-user. As a result, households have lower energy bills, the market for CFLs is stimulated, utilities can better manage peak demand (without the need to build additional power plants just to satisfy peak demand) and increase

grid reliability, local pollutants and greenhouse gas emissions are reduced, and the national economy of energy importing countries is strengthened by conserving scarce foreign exchange.

In the residential sector, lighting and refrigerators/freezers account for the bulk of electricity demand and mitigation potential. It is estimated that there are more than one billion refrigerators in the world that are over twelve years old. Technological advances mean that energy savings of up to 75% (and more with older refrigerators) can be achieved simply by exchanging these old refrigerators for new ones. Also, although a fridge exchange involves higher expenditures than light bulbs, the energy savings are much easier to predict. People switch light bulbs on and off, but refrigerators generally stay plugged in all the time – thus a reduction in their consumption leads to a clearly predictable reduction in base-load: something quite valuable for an energy utility.

Moreover, collecting and recycling old refrigerators and replacing them with the most modern, new units, provides additional benefits that other appliances cannot, such as the avoidance of the release of highly potent greenhouse gases in the form of fluorinated gases as refrigerant and blowing agent for insulation material (HFCs have a global warming potential (GWP) of more than 1300, i.e. 1 kilogram of HFC contributes as much to climate forcing as would 1300 kg of carbon dioxide, and CFCs have a GWP of as much as 10,000). Moreover, CFCs are also an Ozone Depleting Substance; although their manufacture has been banned by the Montreal Protocol, CFCs are still found in old refrigerators around the world, posing a long-term threat to both the ozone layer and the climate system. There are 1.2 to 1.5 billion domestic refrigerators currently in service, representing an estimated bank of 100,000 tons of CFC-12, for example, and approximately 75% of their service refrigerant demand continues to be CFC-12 [2]. Thus there are compelling reasons to dispose of old refrigerators containing these substances as quickly as possible. As a result, several Brazilian utility companies have started to exchange light bulbs and refrigerators in pilot schemes to gather data and operational experience.

Given the significant energy savings and the tremendous environmental added value of replacing old refrigerators, it would appear that refrigerator exchange and recycling programs would be an ideal candidate for the Kyoto Protocol's Clean Development Mechanism, which is designed to accelerate such beneficial action. However, the CDM framework requires a complicated process involving the creation of a methodology, designing of monitoring metrics and the implementation of a project.

Opening Household Refrigeration to the Clean Development Mechanism

In order to accelerate this process, BSH Bosch and Siemens Home Appliances GmbH (BSH) and the German Organization for Technical Cooperation (GTZ) have joined forces to overcome several barriers to open household refrigerators to global carbon markets. The Brazilian context is well suited to demonstrate such CDM projects and to replicate them in all other developing countries that have significant numbers of old refrigerators.

Brazil began some of its first DSM pilots after the power outages in 2001. The projects included a combination of awareness-raising and light bulb and refrigerator replacement. The average household in Brazil uses 20.4% of its electricity consumption for refrigeration, 20.6% to heat water, 12.1% for light and 8.7% for air-conditioning [3]. In a recent testing campaign conducted in the context of the GTZ/BSH partnership, we found that refrigerators in Brazilian favelas (slums) are nearly five times less efficient (871 kWh/year) than the model considered for use under a CDM program (180 kWh/year), even though households struggle to pay their electricity bills (Figure 1). Replacing old refrigerators with energy efficient ones reduces consumption for refrigeration by 80%, and replacing the average new refrigerator with the most energy efficient one by 40%.

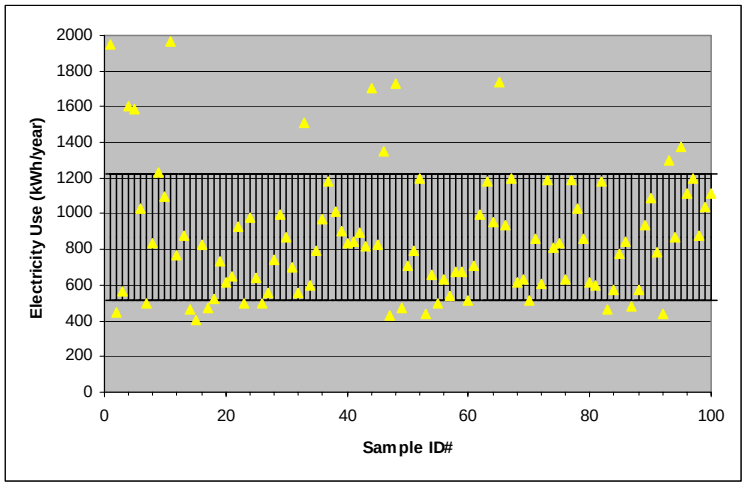


Figure 1. Electricity use of old refrigerators from Brazilian favelas

The average (mean) for the refrigerators tested is 871 kWh/year, with a standard deviation of +/- 352 kWh/year. Over one-quarter of these refrigerators use more than 1000 kWh/year, whereas none use less than 400 kWh/year (more than double the demand of the refrigerator to be used under the project activity).

Four types of barriers exist and each one is being addressed with suitable innovations:

First, the carbon accounting requires foolproof, universal, controllable and low-cost blueprints, so called CDM methodologies, which prescribe exactly how a kilowatt-hour saved is converted into tons of carbon dioxide. This barrier is the most important one because one cannot claim carbon credits unless the CDM Executive Board has approved a suitable and viable methodology. As a centerpiece of the Kyoto Protocol's accuracy and integrity, judgment of a methodology is public and under intense scrutiny. Moreover, the hurdles set by the methodology itself are often decisive in terms of its eventual use.

A blueprint for refrigerators, eloquently dubbed "AMS III.X" was developed by GTZ and BSH and has recently been approved. It allows use of the most widely known refrigerator testing protocol both for the old and the new refrigerators and minimizes the number of tests required. Furthermore, no measurements during the lifetime of the new refrigerators are required. Therefore, the carbon accounting is relatively inexpensive, and it credits all "suppressed demand". In other words, the carbon avoided includes kWh that household physically didn't consume because they switched the refrigerator off to reduce their electricity bill. This is a sometimes overlooked principle in the Kyoto Protocol; essential demand such as refrigeration can be satisfied and the full difference between old and new technology under full service demanded is accountable. By definition, suppressed demand only appears in low-income households. This adds a significant social dimension to CDM by allowing for improvement and development in people's lives. In this case, via improved refrigeration, fewer trips to the grocery store or less spoiled cartons of milk.

Second, management of the refrigerator exchange, including their accounting procedures, needs clear documentation. Whereas this is not the core-business of a utility, BSH is in the position to offer this as a service to the utilities as part of the exchange and the CDM process. The greatest energy savings and with them the largest amount of carbon credits are possible when the oldest refrigerators are exchanged. In the Brazilian context, these are used in households in low-income neighborhoods, such as in Brazilian slums (known as favelas). Brazilian utilities are under pressure from the government to improve service provision in favelas and act as effective conveyors of social policy for these households. Low-income households get subsidized electricity rates, but only if they use less than 100 kWh per month. Often, the old second- or third-hand refrigerators in these households use more than this

amount – meaning that the subsidy is out of reach and paying the full cost of electricity impossible. As a result, many families illegally tap into the electric lines in a manner that is dangerous, highly inefficient and costly to the utilities. Providing them with new refrigerators, lowers their consumption, brings them under the 100 kWh cap and allows them to receive and pay an electricity bill, which in Brazil also opens the door to other social benefits. While exchanging refrigerators in Favelas is complex, it also brings great advantages to the utilities, which reduce theft and transmission losses, as well as to the residents, who enjoy social and economic advantages. Age and poor refrigerator maintenance add to the suppressed demand and both translate into customer regularization and better household services. Now, with the reward from carbon credits, improved services to low-income households are directly connected with global carbon reduction demand.

Third, taking old refrigerators out of use is incomplete unless there is assurance that they are disposed of without new environmental impact. Because refrigerators contain environmentally harmful gasses, the recycling process requires special equipment to ensure they are not released into the atmosphere. Unfortunately, this equipment is not always readily available. The reality is that recycling capacity needs to be created in all developing countries and this requires large investments. BSH is working in partnership with local actors to bring such a recycling plant in Brazil into operation. Combined with this will be measures to establish the carbon accounting necessary for the crucially important fluorinated gases in old refrigerators.

CFC-11 and CFC-12 have been the main destroyers of the ozone layer and old household refrigerators are the largest remaining banks of these gasses globally. CFCs, which are covered by the Montreal Protocol, are not eligible under the Kyoto Protocol but may be eligible for voluntary credits under the Voluntary Carbon Standard (VCS)[1]. As for the energy consumption reduction, this accounting needs to be foolproof, universal, controllable and cheap. The recycling plant is the location where the carbon accounting for CFCs is demonstrated. It is hoped that the income from Verified Emission Reductions (VERs) can cover the investment costs for the facilities, thereby paving the way for investments in many developing countries. Furthermore, AMS III.X requires a 90% recovery of all CFCs, in a so-named "eligibility criteria" (3.l), so the benefits of carbon credits are possible only when non-Kyoto gasses are reduced as well, thereby enlarging the environmental integrity ("conservativeness of a methodology") of the Kyoto Protocol. Imposing the threshold of Greenhouse Warming Potential (GWP) < 15 from the EU Directive 2002/96/EC's as maximum allowed for the refrigerant and foam blowing agent in new refrigerators, the eligibility criteria in AMS III.X, further strengthen this integrity.

Fourth, BSH will establish the first so-called Programme of Activities (PoA) CDM project for refrigerators. This is a new opportunity in the CDM. All CDM projects approved so far are fixed in scale during their lifetime and this imposes that each extension requires the entire transaction cost of at least 15,000 €. The fixed scale has prevented more distributed emission reductions from being realised. PoA is a new mode of CDM implementation, permitting sustained programs, rather than just individual projects, to be pursued by a managing entity. Although the PoA concept was specifically designed to facilitate programs to provide incentives for dispersed, small-scale actions such as end-use efficiency [4], it has gotten off to a slow start since it was introduced about two years ago. So far, nine PoAs are undergoing validation – and some have been at this stage for more than a year – but none registered. In addition to methodological challenges facing all end-use efficiency activities under the CDM, crucial market actors have been reluctant to embrace PoA – for example, DOEs are concerned about liability implications – and some DNAs have not created the legal framework to make it possible for them to issue letters of approval for PoA. Furthermore, potential PoA managing entities lack the necessary capacity. The CDM Executive Board is still considering ways of addressing the key barriers to PoA implementation, such as those noted by market actors in the Call for Public Input on PoA that was undertaken in September 2008 and will consider approving a revised version of the "Procedures for registration of a Programme of

[1] In contrast, the Gold Standard unfortunately does not even allow crediting of reductions in the Kyoto gas HFC-134a, despite the fact that this is included in the approved CDM methodology AMS III.X. and that the methodology is only applicable to projects that include a refrigerator replacement program to improve energy efficiency. Similarly, the Gold Standard for VERs will not allow the resulting non-Kyoto CFCs to be credited, either.

Activities as a single CDM project activity" at its May 2009 session. Not surprisingly given the scope and impact, the initial residential PoA proposals are for solar water heaters and light bulbs. BSH and GTZ have identified the best format for a PoA on exchanging refrigerators across Brazil and will submit the documentation for the approval of a PoA where step by step, new cities can be added. Utilities find the possibility attractive to start in a part of their concession area and then extend the coverage.

CDM Project Innovations State-of-the-Art

Each of the four barriers requires efficient technology and regulatory experience. BSH's main contributions are a refrigerator that is 40% more energy efficient than the best currently available (which is also produced by BSH), and the business strategy of managing the implementation of a CDM project – the logistics of moving appliances. GTZ brings knowledge and experience with the Montreal and Kyoto Protocols, defining the contribution to sustainable development of household appliances in low-income households as well as a strong global reputation for high-quality, diligent and transparent development work. GTZ has also brought in leading external energy efficiency and CDM experts to support methodology development and program design.

When it comes to determining whether the CDM provides a sufficient financial incentive, the capital and transaction costs associated with generating carbon credits relative to CER revenues over time are critical. The primary question is the cost of "producing" the credit i.e. how much do you have to spend to get a CER? Profitability thus depends on key program design choices, such as the cost and performance of the technology employed, how the program is financed, whether CERs are sold via forward contracts or on the spot market, or the cost of complying with the monitoring hurdles created by the chosen methodology.

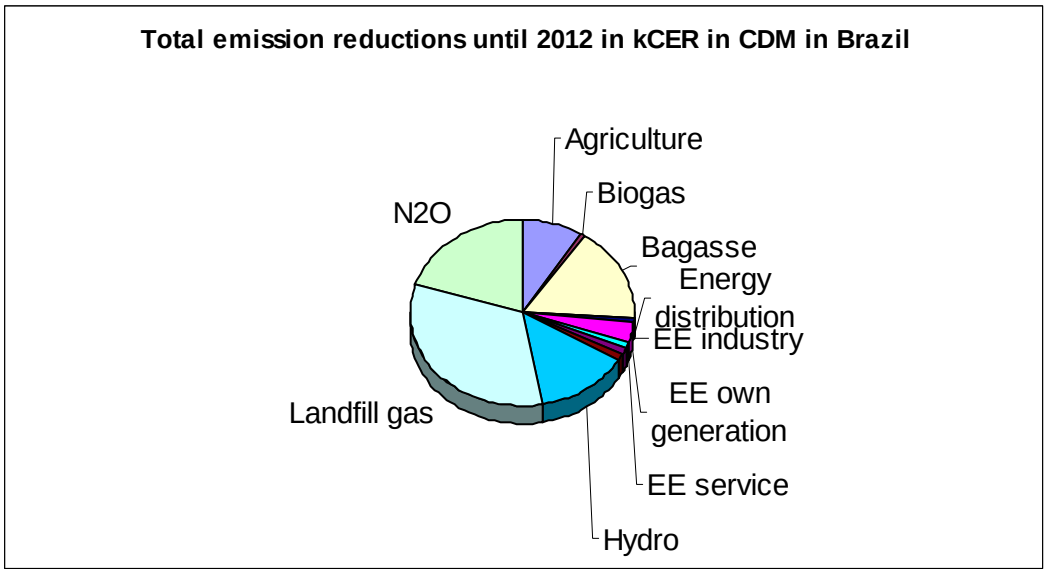
In terms of cost-benefit, refrigerators and light bulbs are the most relevant appliances for low-income households in Brazil and many other developing countries. In other places, building insulation and heating are more relevant as initial steps. Unfortunately, the latter two, while achieving high leverage, are particularly difficult to implement because of the accounting complexities in the methodologies. Therefore, the successful BSH - GTZ public private partnership will assure that refrigerators are the second appliance after light bulbs to be connected to global carbon trading; accelerating the pace toward even greater efficiency while offering consumers the same (if not better) services for lower cost.

The CDM has seen rapid quantitative growth to over US $100 bn traded Certified Emissions Reductions (CERs) in 2008. However, the slow process of defining CDM methodologies has limited qualitative growth. Among 125 approved methodologies, only 17 are used in more than 40 CDM projects, and the UNFCCC secretariat recently compiled a list of 93 methodologies that had been used in 5 or fewer projects that had passed the validation stage[2]. In addition, more than 50% of the methodologies originally proposed (132 proposals) were rejected by the CDM Executive Board for being insufficiently rigorous to comply with the CDM modalities and procedures. Certain sectors, such as energy efficiency, transport and building, are underrepresented and the problems of methodology development have played a large role. For the case of AMS III.X, the time between first submission and approval was 134 days compared to an average for all approved methodologies of 305 days. The first barrier was thus overcome with exceptional speed. The quality of AMS III.X will be visible by the number of CDM projects applying it.

The Brazilian Ministry of the Environment estimates there are 30 mio. refrigerators with CFCs in Brazil, all older than 10 years. If the sampling and testing done by BSH reflects the country average (see Figure 1) and all were replaced with BSH refrigerators, then using AMS III.X to replace them represents 6.5 mio. tons of carbon dioxide, or CERs annually, based on the

[2] EB 47 Proposed Agenda – Annotations (Annex 1)

electricity consumption avoided. This technical potential is theoretical because the subsidies available to utility companies are smaller. In Brazil, there are currently 353 CDM projects of all types at different stages of approval with 34 mio. CER annually. Only seven of these concern energy efficiency and >80% of the CER arise in landfills (methane), bagasse (sugar mills) and hydropower. This bias to single site and large scale is even stronger in Brazil than in India or China. The Brazilian utilities have so far only engaged in small hydropower CDM projects in a few cases and only with minority stakes. International Independent Private Power companies have been more active there.



Source: www.cdmpipeline.org accessed on 11-02-09

Figure 2. Types and size of registered CDM projects in Brazil

The technical potential for refrigerator exchange is larger than the current CDM types, but it is more expensive than the single generation sites with no fuel costs. Light bulbs and water heaters represent a multiple of the potential for refrigerators. It is unknown how large the economic potential in this technical potential for refrigerators is because the benefits to utilities besides the avoided electricity are unknown just as the specific costs of large-scale refrigeration exchanges are uncertain. Furthermore, the tariffs for Brazilian utilities are revised every five years and no adjustments for productivity are possible in between. Some utilities would reduce losses when low-income households' consumption declines below the level where governments pay the bills. It is thus necessary to distinguish the customer classes and define particular refrigerator exchange terms. The economic potential is certainly sensitive to the additional income from global emissions trading. The influence of accounting in utilities is not reflected in the incremental cost curves for emission reductions often cited in policy papers.

Furthermore, the avoided emissions of CFCs are as important as the avoided carbon dioxide emissions from electricity generation. Assuming that half of these old refrigerators have stone wool insulation and half Polyurethane with CFC-11 as foam blowing agent, the recycling of these old refrigerators represents 20.2 mio. tons CO_2e as voluntary carbon reductions out of CFC-11. GTZ has provided advice to the "Gold Standard" and the "Voluntary Carbon Standard", the leading voluntary carbon schemes, to assure that a recycling methodology uses a life-cycle approach to account for the impact of recycling, because only a credible methodology will allow voluntary carbon reductions to be valued at a sufficient price level for recycling capacity investments to become feasible. VCS will soon issue such guidance for CFC methodologies in this standard, whereas CFCs from refrigerator recycling are not eligible under the Gold Standard for VERs.

Programme of Activities (PoA) are intended to be the chosen format for distributed emission reductions such as in household appliances. PoAs for CFL exchange in Mexico and Senegal have been submitted to the U.N.-FCCC and the differences illustrate the different options. In Senegal, it is run by a governmental body (the so-called PoA operating entity) with support from the World Bank buying CERs on behalf of the Italian government (World Bank estimates for Africa as a whole 13.27 mio CERs/year from CFLs, from 17.3 GWh/year saved or 5.28 % of electricity generation in the continent). In contrast in Mexico, the CFL exchange PoA is managed by a private company via retail chains across the country and in competition to government-run CFL programmes (FIDE and CONAE). PoAs for solar water heaters are also prepared by a government agency (Tunisia) and by a private company (South Africa). The correct application of the methodology is the only precondition: otherwise, operational functions in a PoA CDM project can be freely divided between organizations. Who receives the proceeds from the sale of CERs is not defined in a PoA so that risk and rewards can be divided as suitable.

In standard single site CDM, the site operating companies carry most responsibility and reward, but in PoA CDM projects a technology supplier, retailer, or utility has a bigger role and can use different means to reach households. Different PoA CDM projects for the same or overlapping regions will be in a “channel conflict”. BSH’s mastery of the refrigerator methodology is a competitive advantage and combines well with the logistics of moving refrigerators or with the billing and PR by utilities. A PoA design reflecting the refrigerator cost and the recycling can set a trend.

Concerning the accounting and volume of units barrier, all Brazilian utilities are obliged by law to invest 0.5 % of their income in low-income communities or in energy efficiency R&D. With a partially implemented privatization of utilities, these regulations for utilities are not well established. Some utilities prefer the fines rather than offering assistance to low-income communities. The results obtained in the PoA CDM project by BSH, in terms of carbon certificates achieved, operational costs and impact on corporate reputation, will undoubtedly be well visible for the other 30 utilities in Brazil.

Another aspect of this second barrier is the role of the Brazilian climate authority, the so-called Designated National Authority (DNA) that is located in the Brazilian Ministry of Science and Technology. Under the international CDM rules, the DNA of the respective country must approve each CDM project or program. Among the DNA in all developing countries, the Brazilian one has the reputation of being the most competent and thorough. This enhances the demonstration effect of implementing the refrigerator CDM in Brazil, but surely the DNA’s demands have to be met. Of course, offering a CDM project with exceptional social and environmental benefits to the Brazilian DNA, BSH would get particular attention. The Stakeholder Consultation process is a standard part of a CDM projects and the Brazilian DNA has unique demands on the conditions of this process. It is well possible that the Brazilian DNA will also be the only DNA that issues PoA CDM specific regulation.

CDM Projects as a Format of Global Technology Transfer

Scientists around the world are citing increasing concern about the rapid rise in CO_2 concentrations in the atmosphere. Achieving a maximum level of 500ppm (some say only 350ppm) is imperative to avoiding potentially catastrophic increases in global temperature above 2° Celsius. This will not be achieved by emission reductions in the industrialized world alone. As a result, pressure is mounting on the large developing countries like Brazil, China and India to accept commitments to stabilize and eventually reduce their greenhouse gas emissions. Concurrently, the desire and need for developing nations to provide their citizens first with access to modern forms of energy and subsequently with increasingly higher standards of living remains as strong as ever. As a result, there is enormous pressure to find fast, efficient and large-scale solutions for “leap-frogging” the dirtier period of development.

This will require cleaner and more efficient ways to produce electricity on the supply-side. However, it will also require serious thinking and incentive mechanisms that allow for dramatic and continuous improvement in efficiency.

The next Conference of the Parties to the UN Framework Convention on Climate Change and Meeting of the Parties to the Kyoto Protocol in Copenhagen in December 2009 is expected to lay the ground for the future global climate policy regime, which may or may not include an additional commitment period within the context of the Kyoto Protocol. Since climate change is a challenge faced by all people in all countries, providing consumers with the right motivation and economic incentives to make environmentally responsible choices will be a valuable component to the overall effort. The Brazilian DNA is keen on showing the potential of PoA CDM projects to contribute to emission reduction commitments, see a public comment on [[5]]. With large hydropower, Brazil can benefit from global emissions trading more on the demand side, which may prove the better option.. Refrigerators have consistently been one of the largest energy-consuming devices owned by individuals. They are also one of the first items that emerging consumers purchase. The impact of replacing the oldest units with the most efficiency can prove an enormous global contribution. BSH and GTZ are continuing to work to ensure the necessary infrastructure is in place to make this happen.

All leading technology suppliers gain a competitive advantage by adding CDM to their marketing as they offer the highest emission reduction. This is an indirect outcome of emissions trading which depends on suitable CDM methodologies and these suppliers learning how to shape CDM projects. Furthermore, helping utilities undertake large DSM programmes is an important form of Transfer of Technology, a key issue in the Bali Action Plan. Only the methodology and the recycling barriers are the same for all countries, and the other two barriers, the adaptation of the exchange to households and the design of PoA, require new solutions in each country.

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