Energy for a sustainable future means fulfilling demand efficiently, drawing on renewable sources. It involves providing sustainable energy services and solutions, sometimes requiring off-grid solutions or the development of more effective technologies and infrastructures to optimize energy production and consumption.

Favela Cool against Global Warming

*By **Christina Gradl** and **Aline Krämer***

German appliance manufacturer BSH Bosch und Siemens Hausgeräte GmbH (BSH) has established a refrigerator replacement programme which provides fridges to the Brazilian poor for free – and makes a profit from it. How is this possible? The source of this unusual business model is legislation passed by the Brazilian government which requires that all energy providers in the country invest half a percent of their total turnover in energy-saving measures, and half of that in poor districts. To comply with this regulation, energy suppliers started to implement awareness-raising programmes about saving energy in shantytowns, or favelas, exchanged light bulbs, and finally turned to the refrigerator as one of the household appliances consuming most energy.

Currently, about 38 million refrigerators in Brazilian homes are more than 10 years old, six million are even older than 20 years. "Some fridges don't even have a door, because if you are stealing electricity anyway, you are not bothered about electricity consumption," explains Dirk Hoffmann, BSH Senior Vice President for Growth Markets Sales. The old fridges use an average of 880 kilowatt hours per year, whereas the newest BSH fridges use no more than 180 kilowatt hours.

Through the fridge exchange programme, everybody benefits: poor households get a brand new appliance and, in addition, the household reduces energy consumption tremendously, and it becomes eligible for government programmes that subsidize the energy consumption of poor families up to 100kWh. Not only does the family get a free, legal connection, it also gets an energy bill that serves as proof of residence, opening the door to other social programmes. The utilities, in turn, increase their revenues by gaining new customers and by avoiding the huge transmission losses of around 30% caused by illegal tapping. And BSH sells more fridges.

There is another beneficiary: global society, threatened by climate change. Every fridge that is replaced saves on average 210 kilograms of CO_2 emissions per year. Over the past year, BSH has already replaced over 80,000 refrigerators in the slums of Brazilian cities, cutting overall annual CO_2 emissions by 12,800 tonnes. Recently, BSH has managed to capitalize on that by getting a methodology approved for generating carbon credits with the Clean Development Mechanism (CDM). And, although BSH recently sold its operations in Brazil, the methodology and model are viable and can be replicated anywhere in the world where conditions are appropriate. We interviewed Samuel Shiroff, who led this initiative for BSH.

Interview with Samuel Neal Shiroff, Project Leader, BSH Bosch und Siemens Hausgeräte GmbH

Samuel Neal Shiroff is a director in the Growth Markets department at Bosch and Siemens Home Appliances Group located in Munich, Germany. Sam is responsible for developing and implementing the business models based on the Clean Development Mechanism (CDM) of the Kyoto Protocol. BSH is currently active in this area with its new technology "Protos" plant oil cooking stove, as well as with the replacement of very old refrigerators in the developing world.

Before joining BSH, Sam was the executive director of the Bellagio Forum for Sustainable Development and represented Deutsche Bank's investment in the Prototype Carbon Fund of the World Bank.

– How did the idea to access the carbon market with the fridge exchange programme originate?

– We first started working on this idea in the context of another project, the plant oil cooking stove Protos. This is a technology we are working on for developing countries. The customers there are often very poor. One of the ways that we were attempting to provide the product at a cost that can be affordable is through carbon credits. Through Protos we had established a good working relationship with the German Development Agency, GTZ; and in our conversations we started talking about other appliances – specifically refrigerators and potential carbon credits from electricity savings and from recycling refrigerators that contain HFCs.

A typical Brazilian Favela. *BSH.*

Glossary

CDM: the Clean Development Mechanism is an arrangement under the Kyoto Protocol allowing industrialized countries with a greenhouse gas reduction commitment to invest in projects that reduce emissions in developing countries as an alternative to reductions in their own countries.
CERs: Certified Emission Reductions are carbon credits issued by the CDM Executive Board for emission reductions achieved by CDM projects.
VERs: Voluntary Emission Reductions are carbon credits produced outside a legal framework.
CFC: Chloro Fluoro Carbons are chemicals composed of carbon, chlorine, and fluorine. They are used in the manufacture of aerosol sprays, blowing agents for foams and packing materials, as solvents, and as refrigerants. They cause depletion of the earth's ozone layer and contribute heavily to global warming.
HFC: Hydro Fluoro Carbons are chemicals composed of carbon, hydrogen and fluorine (no chlorine). They have no known effects on the ozone layer, but do contribute significantly to climate change, being up to 12,500 times as potent as carbon dioxide in global warming. They are targets of the Kyoto Protocol and a significant share of CERs are from HFCs

– What role did GTZ play in the development of the carbon credit programme?

– GTZ is an equal partner in this public-private partnership which is really taking advantage of good synergies: we provide information, input and expertise as a refrigerator manufacturer that is a global leader in energy efficiency and the GTZ provides expertise on CDM as well as other development-related issues. I think there is a lot of strength in this partnership.

– How are the carbon savings calculated?

– There are the two ways to generate CERs. First, carbon saved from increasing energy efficiency is calculated as follows: Old fridge energy usage minus new electricity usage times the emissions factor times the number of years. The difference in transmission losses is also included. Second, recycling refrigerators that contain HFCs generates credits for the amount of HFCs captured.

– What is the status quo regarding the safe disposal of old refrigerators in Brazil?

– At best, the gas from the compressor is removed during the recycling. The foam is simply left to emit whatever it contains. At worst, everything is just released to the atmosphere because people take the copper off the compressors to sell it. We are moving forward to change that and establish processes through which all of the environmentally harmful gases are captured and destroyed.

– How much revenue could be generated from CFC capture?

– CFCs are not eligible for CERs because they are covered by the Montreal Protocol on substances that deplete the ozone layer, and thus not applicable for the Kyoto Protocol. Montreal currently provides no funding for the destruction of CFCs contained in old fridges. Thus these gases, which are extremely harmful for the ozone layer and the climate, are left to be released into the atmosphere because there is no incentive to capture them.

We are hoping to change this incentive by generating voluntary credits for them. But prices on the voluntary market vary - credits are simply worth what a buyer is willing to pay for them. A refrigerator may contain CFCs worth the equivalent of 3 to 5 tonnes of CO_2. To pay for the cost of recycling, the minimum price per tonne would need to be around €3 to €5. Clearly, the higher the price, the stronger will be the incentive to get these fridges disposed of in an environmentally responsible manner.

A family in front of their new highly efficient fridge. *BSH.*

However, several additional issues complicate this area of carbon trading:

First, voluntary credits from CFC capture could really flood the market. A million fridges would suddenly generate 5 million voluntary credits, and that just from one part of Brazil. A large supply would lower the value of those credits and thus create a negative dynamic.

Second, unless a closed system comprising the entire life cycle exists, it will be unclear what gas is in the new fridge that inevitably replaced the old one. If it is an HFC, one gas with high global warming potential simply replaces another – which is far less desirable than using a climate-friendly coolant.

Third, if it becomes profitable to recycle CFC refrigerators in developing countries, this may be an incentive to ship fridges from the industrialized countries to developing countries to claim credits. This is obviously not a good idea.

– Who receives the revenues from the carbon credit sales? BSH or the utilities that purchase the fridges, or both?

– From an efficiency viewpoint it makes more sense for BSH to be the entity that manages all relevant activities. If each individual energy company sets up its own CDM department and is managing its own refrigerator exchange programme, the costs multiply many times. If BSH does it throughout a country, it is simply more efficient.

However, we are an appliance manufacturer, not a carbon credit company, and therefore, we are very flexible. If the utility wants all the credits we have no problem with that. Obviously the costs and the risks need to be shared. It is simply a matter of negotiating the best way to share all of the benefits of the project.

– How predictable are savings from fridge replacements?

– With fridge replacements, there is very little if any real behaviour change. The only potential change is that customers may no longer unplug the fridge, because with much lower energy consumption, they can now afford continuous cooling. This makes exchanging refrigerators one of the most

A typical Brazilian Favela. *BSH.*

predictable energy savings opportunities for a country.

By contrast, if you exchange light bulbs, behaviour can change. People have less incentive to switch the light off if they are not paying as much. Low-energy light bulbs seem very effective because they are cheap and promise high energy savings. But actual savings are harder to predict and certainly harder to measure.

– Do you consider replicating the model in other regions?

– We are in a process of exploring where conditions are appropriate in other countries. Obviously it is in our interest to make governments aware of what is possible: the more refrigerators you replace with our highly efficient products, the more CO_2 savings you generate.

Here, national emissions factors play an important role: while the costs for the refrigerator, the transportation and the management are essentially the same no matter where in the world, the amount of carbon credits generated depends on the emissions factor of the country.

– Could similar incentives for fridge exchanges be created in developed countries?

– Ultimately, it is about making savings in energy and environmental costs pay for the consumer. Low electricity prices mean that consumers are often not able to recoup the additional cost of a more efficient appliance via the lower operating costs over a reasonable period of time. Thus, incentives that reward more efficient appliances – whether it is through carbon credits or tax incentives or some other mechanism – would indeed help to encourage customers to purchase more efficient appliances. BSH would certainly be very open to such incentives.

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Towards a brighter future

By ***Dorcas Cheng-Tozun***

When the sun sets this evening, about 1.6 billion people worldwide will conduct night-time work, study, cook, and socialize in near-darkness. For families without access to electricity, one of the few options for light will be the kerosene lantern, which is about 100 times dimmer than a single incandescent bulb.

Kerosene comes at a very high cost: it is both expensive – costing as much as $10 per month for dollar-a-day families – and dangerous, leading to respiratory infections and deadly fires. In addition, millions of tonnes of carbon emissions are released every year from burning kerosene.

The D.light Solata is one of the most affordable solar lamps available to households like this one in Tanzania. The light provided can enable activities for multiple family members. *Theo Steemers/D.light Design.*

One of the most significant benefits of brighter and more dependable lighting is that children and young people can study for longer hours, thus increasing the rate of learning and increasing their potential for a bright future. *D.light Design.*

For the poorest households in the world, the benefits of modern lighting alternatives are clear, resulting in higher incomes through increased productivity and improved educational outcomes for children. Lives are saved due to the reduced risk of kerosene fire and indoor pollution.

D.light Design, a for-profit social enterprise founded in 2007, is one of the key players at the forefront of providing product solutions for bottom-of-the-pyramid households. The venture capital funded company wants to replace every kerosene lantern in the world with clean, safe and bright light. The enterprise is committed to using the very best design principles to create products for the developing world, resulting in lighting and energy solutions that are appropriate, high-quality and affordable.

In 2008, D.light introduced a product line of solar-rechargeable light-emitting diode (LED) lights, the Nova Series and the Solata, that provide up to 32 hours of bright light on a full charge. The products utilize the latest and best LED and solar technology in the world, providing safe and high-quality replacements for kerosene lanterns and other hazardous or unreliable power sources.

With a retail price range of about $12 to $40, these products are among the lowest cost solar lights available in the developing world. The affordability and durability of the products ensures that more families can permanently choose to leave behind dangerous and dirty fuel-based lighting sources. The products also offer features such as AC-charging, fast-charging, voltage spike protection, and mobile phone charging. As such, they are designed specifically for the particular challenges of our customers' environments and for meeting their energy needs to enhance their quality of life even beyond lighting.

Since 2008, D.light has established sales offices in India and East Africa. The need in these particular markets is immense: about 500 million people in India alone have access to no or only intermittent electricity; the East Africa region is home to another 150 million off-grid customers. D.light is also actively partnering with diverse distribution partners throughout the world, utilizing regular market, NGO and financing channels to increase the reach of its products.

Customer response has been extremely positive, and the measurable impacts encouraging. In one village in India, all 47 households were able to purchase a D.light Nova through an innovative financing model offered by a US-based NGO partner. With a small down payment and low monthly payments, the products became very affordable for even extremely low income families. Within two months, the entire village reported an average increase in monthly household income by 50%, from $12 to $18. Families also experienced cost savings from no longer having to purchase kerosene, as well as improved study conditions and indoor air quality. Several months after the project, the repayment rate of all 47 households has been 100%.

D.light's target is to replace at least 20 million kerosene lanterns with solar-rechargeable lights by 2020. About one year after the product launch, over 200,000 lives have already been positively impacted with clean, safe and bright light. As the company continues to scale up, this ambitious target – and the large-scale change it will bring – could well be within reach.

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Off-grid Renewable Energy Solutions in Bangladesh

Grameen Shakti in Bangladesh is one of the largest and fastest growing rural based renewable energy companies in the world. It was initiated in 1996 by the core-builders of Grameen Bank in order to rescue the rural people from energy poverty which hampers their social and economic development. Inspired by the vision of Professor Yunus who has great faith in the modern technology and inherent creativity and capacity of the rural people, Mr Dipal Barua, the company's Managing Director and one of the core-builders of Grameen Bank, wanted to create a synergy between renewable energy technology and micro-credit in order to give the rural people a chance to improve their quality of life and also take part in income generating activities.

Through its innovative microcredit scheme, Grameen Shakti has embarked on an ambitious programme to provide a range of affordable renewable energy technologies to rural households. Already, more than 205,000 homes across Bangladesh have installed PV solar systems capable of powering lights and small-scale electronic appliances. Over 8,000 PV solar systems are being installed per month, and demand for the systems is increasing exponentially. The goal is to install two million PV solar systems in homes by 2011 and seven and a half million by 2015, which would reach half of the rural population of Bangladesh.

In addition, Grameen Shakti has installed 6,000 biogas plants, which convert animal dung and organic litter into biogas and slurry. The biogas can be used to cook food, for lighting and to produce electricity. The slurry is used as organic fertilizer and as fish feed. Grameen Shakti has a goal of building 500,000 biogas plants by 2015. Grameen Shakti has also disseminated over 20,000 improved cooking stoves and has the goal of providing one million stoves by 2010 covering 35,000 villages.

The employment and other socio-economic opportunities of the programme are far-reaching. At least 20,000 jobs have already been created with the current uptake of these three renewable energy technologies across Bangladesh. The goal is to create at least 100,000 jobs, mainly for women, by 2015.

Grameen Shakti is an example of a decentralized solution to clean energy for the poor, which is especially powerful as it is commercial in operation and microfinance-driven, and as it substitutes kerosene (the usual lighting fuel, held responsible for respiratory diseases) with photovoltaic electricity, biogas and improved stoves. Thus it addresses health, environment and poverty at the same time, aiming at a future where rural households of Bangladesh would have access to environment friendly and non-fossil energy at affordable costs.

Sources: UNEP (2009): Global Green New Deal: Policy Brief. (Original source: Barua, Dipal: "Bringing Green Energy, Health, Income and Green Jobs to Bangladesh." Presentation at the Preparatory Meeting, International Advisory Board to the International Climate Protection Initiative of the German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety. Poznan, Poland, December 7, 2008).
Grameen Shakti website: www.gshakti.org.