

Solar Home System



<http://www.ashdenawards.org/winners/SEF09#>

The Solar Energy Foundation has created a solar home system in hopes of replacing the kerosene lamp. It is comprised of a 10Wp PV module, 18 AH battery, charger controller and four LED lights. This amount of energy provides lighting and powers small entertainment devices such as radios for about four hours a day. The components are imported but they are assembled in Ethiopia. The result of this program so far has been a reduction of 650 tonnes/year of CO₂. (The Ashden Awards for Sustainable Energy, Solar Energy Foundation) I am not sure if in the calculations they have made regarding CO₂ reductions includes the embodied energy of the components, so the overall total might be less. This is a great clean technology in that it has shown clear reductions in CO₂, but it has also done a great deal for the community. The Solar Energy Foundation has set up an International Solar School to train people in the community how to install and maintain these solar systems. They are also taught important business skills. At this time, residents of Rema, Ethiopia pay a monthly fee somewhere between 9 cents and a \$1.20 for maintenance work done by local technicians and pay for replacement parts. In this instance, capital costs were financed by a donor, but future costs will be paid by the village itself, either directly or through a loan. The system costs \$260 which can seem like a lot for such high-need communities but this example has shown that it has been a worthwhile investment for the community. Rema was offered a diesel generator by an NGO but chose this system instead because they were worried about the costs of fuel. A well with a PV pump can also be added for a small fee. This well will save women two hours a day since they will no longer have to walk miles to get water. (The Ashden Awards for Sustainable Energy, Solar Energy Foundation)

This has been a highly beneficial project for the village. People are reducing their greenhouse gas emissions by no longer using kerosene. They are receiving training and better jobs as a result of these installations. According to the case study done by the Ashden Awards, “The village teacher thinks that grades in the primary school have improved 75% as a result of the PV lighting.” A night school has also been set up to tutor adults, thus increasing the literacy rate. (The Ashden Awards for Sustainable Energy, Solar Energy Foundation) It is amazing what an impact solar energy can have, not just on energy production, but on the whole community.

Tough Stuff Solar Panel



<http://www.toughstuffonline.com/>

<http://www.toughstuffonline.com/about/>

This solar system is fascinating not just because of the technology, but also because of the unique business plan. These 1-watt systems are used to power small lights, charge phones, and power radios. The panel costs under \$15 and the payback period is just twelve weeks. The founders of this system, Andrew Tanswell and Adriaan Mol, decided to sell these lightweight, durable panels in order to avoid the inefficiencies that

sometimes occur within the aid process. They felt that it would demand that they create products that people actually want to use. They employ locals to sell the panels and who then receive 30% of the profits. These panels have no glass, are practically indestructible and require little to no technical knowledge. There are currently pilot projects in 26 countries and they plan to expand the business into distribution systems. (Marlow) I am including a link to their 60 second overview on Youtube as it offers a good look into what they are doing with this product:

http://www.youtube.com/watch?v=xTyxScb8lGM&feature=player_embedded

The thing that I truly love about this system is that it is just so easy. It really is inexpensive and they have a buy one fund one option so that outside people can help. For \$30, a person can buy a panel and lamp and then half of that cost goes to fund a solar entrepreneur. After researching for this project, I actually purchased a panel through the buy one, fund one system. I will be sure to bring it into class once I receive it. These panels can be used for camping or hiking since they are so sturdy and those activities don't necessarily require a lot of energy use. I think the fact that you don't need six weeks of training to operate or install one of these items is a huge bonus over the solar home system. It allows villagers to have access to solar energy immediately and prevents them from having to pay that monthly maintenance fee. What I find disagreeable about this product is that the cord plugs into other Tough Stuff products. I don't know if it can be used with other brands. I understand that this is probably necessary in terms of their business model, but from the perspective of high-need communities who may be offered lights or equipment, from NGOs, that are not compatible then it seems to be a negative.

Solar Cooker



http://solarworldidea.com/wp-content/themes/solarworld_v1/images/projects/solar_cooker2.jpg

Solar cookers or solar ovens are portable cooking devices that cook food by the power of the sun. The main draws of this type of oven is that those in developing countries will no longer have to spend hours collecting sticks for firewood. Trees will not be cut down in effect releasing carbon into the atmosphere. Solar cookers typically fall in one of three designs: a parabolic cooker, which has reflective material shaped like a parabola that focuses light on a single source; a panel cooker, which has flat panels that direct the light to a certain area; and a box cooker, which is an insulated reflective box with a plastic top to allow sunlight in it. Solar ovens can be relatively inexpensive and a number of organizations fund solar oven implementation in other countries. For instance, Dr. Steven E. Jones from Brigham Young University set about creating solar oven designs that would be effective and practical in developing countries where money and materials may be more difficult to find. He then approached various NGOs about implementation and distribution of their system. (Currit and Jones)



<http://www.angelfire.com/80s/shobhapardeshi/ParvatiCooker.html>

I appreciate that Dr. Jones looked at the big picture when creating his design. He designed a funnel shaped solar cooker, but included other designs that might work for different areas in the materials he sent out to various NGOs. His intention was to provide numerous options that could fit the particular circumstances facing those in developing countries. Time was taken to find designs that would maximize the use of local materials and groups were chosen based on their work of empowering locals to use this as a business opportunity. (Currit and Jones) The use of local materials has a tremendous impact on CO₂ emissions. Any shipping will increase the total overall emissions of the project. If the materials for each box were shipped than the benefits gained from the solar oven would be a bit diminished by the energy it took to ship it.



<http://www.solarovens.org/sossport.html>

The oven Dr. Jones designed is more of a makeshift item that is marketed towards NGOs than a commercial enterprise. Solar ovens are also sold commercially. The Solar Oven Society has created the solar sport oven which they advertise for camping and hunting. It is about \$190 and can be used to cook all kinds of food with minimal water added and can be used for baking. In fact, it comes with a water pasteurization indicator so you can make sure that your water is drinkable. (Solar Oven Society) Although it is advertised for recreation, it could be just as easily used in your home. Household gas cooking creates a carbon dioxide output of about 150kg per year and is responsible for about 5% of total energy use in the EU. (Goodall p.120) Some of this could be offset by switching to solar cooking when it is available. This is an easy option for individuals looking to lessen their energy usage. Food can be put in and left out there with no risk of burning. Supposedly, food tastes better when it is cooked in a solar oven, so you are not sacrificing taste for energy usage either. Finally in terms of this particular oven, a portion of every purchase goes towards providing people in Afghanistan and Ethiopia with their own solar sport, so it has twice the benefit

Solar Lantern



<http://www.treehugger.com/files/2009/10/cheapest-solar-lantern-aims-to-displace-kerosene-lamps.php>

The company D. Light has created this solar lantern called the Kiran. Some are looking to this light to replace the kerosene lamp altogether. It costs just \$10 and can provide 4 hours of lighting in its high setting or 8 hours of lighting in the low setting. It requires 8 hours of charging, unless you plug it in an AC adapter in which case it will only take 4 hours. The company says that is very durable and that the quality of lighting may even surpass that from kerosene. (Heimbuch)

The Kiran is designed with developing countries in mind, but I do not see any reason why it could not be used in more developed countries as well. Lighting contributes to 3.5% of residential end use energy. (Randolph and Masters p. 326) In the UK, lighting accounts for 9 million tonnes of carbon dioxide a year. (Goodall p. 125) Any small measure can help reduce energy bills and reduce CO₂ emissions. I don't know if people are ready to use something that resembles a camping light in their homes just yet, but it is portable and provides good lighting. Perhaps a better use for it right now is as outdoor lighting on porches or decks. I know at my parent's house in New Jersey, there are five lights on our deck. This could be left out on our deck during the daytime and then used at night for social gatherings. The deck and corresponding deck lights are used primarily in summertime anyway so it would be a great fit. The Kiran could also be used inside houses if people are trying to save on lighting or are interested in solar technology but cannot afford expensive PV systems just yet. Using this solar lantern can also help

decrease air conditioning loads in the summer. Randolph and Masters point out in Energy for Sustainability that “The inefficient standard incandescent lightbulb is more of a heater than a light source, but it still provides about 85% of household illumination”. (Randolph and Masters p. 328-329) If people were willing to use such solar lanterns for lighting in the summer they would need the air conditioner less and therefore reduce CO2 emissions and save on energy bills.

Passive Solar Greenhouses in India



Himalayan Ladakh region has a mere 90 days that crops can be grown outside, but there are 300 sunny days a year. GERES (Groupe energies renouvelables, environnement et solidarités) has designed these greenhouses that use local materials and can be built by members of the community. They cost \$600, 75% of which the owner will have to provide in cash and kind. This is a lot of money but the greenhouse allows crops to be grown throughout winter thus substantially increasing the income of these families. Thus far there has been evidence of improved health, a 30% increase in income, a reduction of 460 tonnes/year of CO2 since vegetables no longer need to be transported by truck, and the status of women has somewhat improved. The building and payment structure is designed so that families can make some of the materials in the spring and then build it after the growing season when they more labor and funds are available.

Source:

http://www.ashdenawards.org/files/reports/GERES_case_study_2009_final_map.pdf

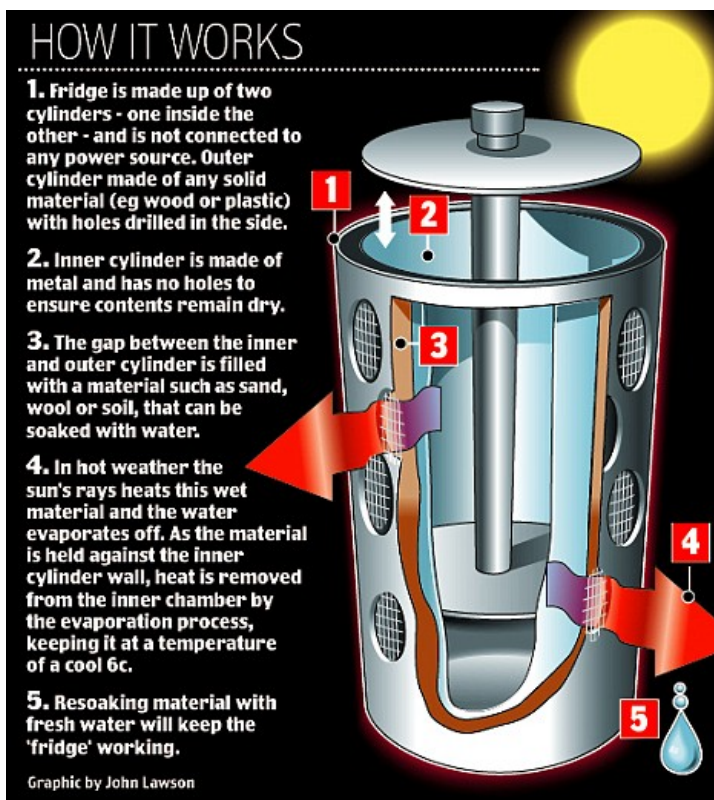
Solar Wi-Fi



Green Wi-Fi is a non-profit who is aiming to provide Wi-Fi to schools and communities in developing countries. Their guiding principle is that the welfare of the world is largely dependent on children having free access to information. All it needs is a single source of broadband access and it can create an internet network right out of the box. It is designed with to use inexpensive components, the latest solar tech advancements and open access software. Their system is designed to complement such initiatives as One Laptop per Child and Intel's World Ahead Program.

Sources: http://www.treehugger.com/files/2006/08/solar_wifi_to_b.php
http://www.green-wifi.org/about_us/mission/

Solar-Powered Fridge



This is fascinating because it can be made with recycled material, it needs no electricity, and is filled with sand or soil which is readily available. Emily Cummins has invented this portable solar fridge that can hold medicines that need to be kept cold or small amounts of food. She traveled to Namibia and helped make 50 fridges. The project has since branched out in Zambia and South Africa. She predicts thousands will be made as a result of word of mouth.

Sources: <http://www.inhabitat.com/2009/01/12/solar-powered-fridge-by-emily-cummins/>
<http://www.dailymail.co.uk/sciencetech/article-1108343/Amazing-solar-powered-fridge-invented-British-student-potting-shed-helps-poverty-stricken-Africans.html>

Energy Efficient Wood Stove



<http://www.ashdenawards.org/winners/Aprovecho09#>

According to the World Health Organization, “over three billion people worldwide e cook with wood, animal dung, or coal and other solid fuels on open fires or traditional stoves”. (WHO: World Health Organization) An efficient wood stove is a better option than having an open fire to heat or cook food. “Open fires do not provide anywhere near as much useful heat to the room as a wood stove, which operates at 70 percent efficiency or more.” (Goodall p. 273) Cutting down trees to use for cooking and heating will release carbon dioxide into the atmosphere, but since the woodstove will use less wood than what was being used in open fires it is typically an upgrade. If it is possible to combine the use of more efficient cooking stoves with reforestation plans then the there will be no real net emissions. (Goodall p. 272) The Aprovecho Research Center and the Shengzhou Stove Manufacturer have designed and mass produced a more efficient wood and charcoal burning stove. It is designed in a rocket shape to better control air flow so that wood is burned cleanly and heat is transferred efficiently to the cooking pot. The stoves are made from clay that is fired into a lightweight durable and insulating ceramic. Field tests have shown a 40% savings in fuelwood, 50%-70% reduction in particulate emissions, and 50%-60% reduction in CO2 emissions as compared to your typical

cooking fire. They say the typical savings is 1 to 2 tonnes of CO₂ a year per stove. (Ashden Awards for Sustainability: Aprovecho Research Center and Shengzhou Stove Manufacturer)

An increase in efficiency of this type of cooking could have a huge impact on CO₂ emissions. It would be better to see renewable that did not rely on wood for cooking but this is step in the right direction as we wait for technologies to advance and become more affordable. These stoves are shipped from China to Africa and India which adds to the CO₂ emissions, but the clay is bought from a local mine and the stoves are dried by waste heat from the ceramic kilns. (Ashden Awards for Sustainability: Aprovecho Research Center and Shengzhou Stove Manufacturer) It is promising to see that there has obviously been some thought to using energy efficiently. Stoves cost between \$3.50 and \$12 and are sold commercially, through subsidies or micro-credit, or provided free to refugee camps. They are relatively portable so they can be moved outside in summer and moved back inside to provide space heating in the winter. Up until 2008, they had sold 60,000 stoves but expected to sell 200,000 to 300,000 in 2009-2010. (Ashden Awards for Sustainability: Aprovecho Research Center and Shengzhou Stove Manufacturer) Given these numbers there seems to be a growing interest in this technology. Eventually the goal should be to stop using wood for cooking, but this is a great interim technology as we await further advancements in solar and wind.

Domestic Biogas Plants



<http://www.ashdenawards.org/winners/bsp#>

A biogas digester is a temperature controlled tank, where manure or food waste is broken down into methane or biogas by some sort of microbial action. Manure is responsible for 400 million tons of CO₂-equivalent, so it is necessary to manage it appropriately if we

want to decrease CO₂ emissions. (Scherr and Sthapit p. 41) The Biogas Sector Partnership in Nepal has installed domestic biogas plants that use cattle manure for lighting and cooking. By 2005, they had installed 124,000 domestic biogas plants. Additionally they were able to install toilets to 75% of the homes in connection with the biogas plants, thus providing numerous additional health benefits. Once the manure is broken down the gas is used for cooking and lighting and the remaining material is used as organic compost. This system is a bit more expensive than some others discussed, costing between 170 and 220 pounds. BNP allows families to pay for a third of this in kind by providing labor during installation and by providing materials. (Ashden Awards for Sustainable Energy: Biogas Sector Partnership, Nepal) I think this is a brilliant idea because it both reduces the price and gets the whole community involved.

This leaves 2/3 of the cost remaining, but in Nepal it is relatively easy to get financing since biogas plants have proved so successful. Families typically are able to pay back the loan within eighteen months, since this is about the time it takes to begin seeing savings from no longer purchasing fuelwood. A case study on these biogas plants was done in 2005. At that time, 375,000 tonnes of fuelwood were being saved per year and a net reduction of 660,000 tonnes a year of CO₂ equivalent was seen. The one negative of this system is that there is a small net methane emission due to unburned methane in cooking that leaks from plants. (Ashden Awards for Sustainable Energy: Biogas Sector Partnership, Nepal) This could be problematic since methane traps 25 times more of the sun's heat than CO₂ does. (Simpson p.32) It does not seem to negate the effect of CO₂ reduction, but hopefully future version of this biogas plant will be able to address the problem. Overall I think this system has great potential. It reduces CO₂ emissions, provides organic compost that should increase the viability and productivity of the land, and addresses many serious health concerns.

Treadle Pumps



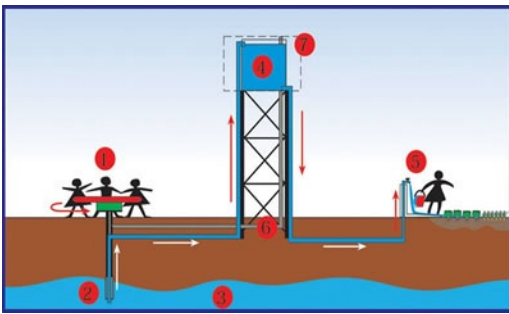
http://www.ashdenawards.org/our_work#

Treadle pumps are foot operated pumps used for irrigation. This pump is great because it allows farmers to grow one or two additional crops. This provides more food, more income and is better for the land. Monocultures are notoriously more destructive to the land, so this will help an overall land management scheme. International Development Enterprises India (IDEI) has set up a pump that people power by standing on two bamboo treadles. They describe it as similar to a step machine. This operates two metal pump-cylinders that are connected to a tube well. Water is lifted to the surface through this movement as opposed to being pumped by a fossil fuel powered engine. They need to be operated for two to eight hours a day, but this can be done at any point in the day. It has the added benefit of allowing children to operate the pump for a short period of time and then being able to stop and leave for school without disrupting the irrigation. It does not seem to create more labor for families. (Ashden Awards for Sustainable Energy: International Development Enterprises, India)

They cost between \$20 and \$32 with an additional fee of \$11 for tube well and installation. Most farmers buy them directly through an IDEI dealer, some of whom offer credit programs. There have been 750,000 total sales to date which equates to 1.45 million tonnes of CO₂ saved. There are a number of benefits of this system. It replaces diesel generators thus saving the above mentioned amount of CO₂. It increases the number of crops that can be grown on a field, thus increasing the CO₂ sequestering capability, enhancing the quality of the land, and increasing the incomes of the families who use them. In addition, this system pumps water slow enough that you do not see the erosion that comes from diesel generated pumps. The slow speed also lessens the amount

of surface water there are fewer bugs attracted to the crops. This decreases the need for pesticides, which in turn brings up the quality of the land. (Ashden Awards for Sustainable Energy: International Development Enterprises, India) My only concern is that if pumps such as this are not used along with a comprehensive water management plan then it could exacerbate water shortages in the future. I believe that any irrigation plan needs to coincide with rainwater harvesting practices.

Merry-Go- Round Pump



<http://www.treehugger.com/files/2008/03/merry-go-round-pump.php>

Play Pump, a South African NGO, has developed a merry-go round pump that pumps water while allowing kids to play. As children spin around on the merry-go-round, water is pumped from a well up into a tank 7 meters above the ground. This is then attached to a tap which provides clean drinking water. These pumps are capable of drawing 1,400 litres per hour of clean drinking water. Water can be drawn from as deep as 100m in the ground. There are play pumps located in a number of communities throughout Africa and there are plans for expansion in the future. (Kloosterman) The merry-go-round pumps are rather expensive at price of \$14,000. All of the pumps so far installed have been donated and their website makes no mention of communities purchasing their own. You can donate one online in its entirety or you can give a certain amount of money

towards one. (Playpumps International and the PlayPump water system. Kids play. Water Pumps!")

I think this is an absolutely ingenious idea. Many children have to walk miles to get clean drinking water, but this invention allows them to play and produce clean water while they are doing so. It has obvious health benefits and it reduces CO2 emissions by negating the use of diesel powered pump. I would have the same criticism of this pump as the one above, and that is that it needs to be linked to some sort of water management system. My other criticism is that it is very expensive. I would go so far as to say that it is not really in the same category as the other technologies discussed in terms of its relationship to high-need communities. I just had to include it in the discussion because I think it is so fantastic. It is one of the only products I have seen that addresses the fact that kids are allowed to be kids in some countries, but not in all of them. It seems like more of an equity issue

Mini-Hydro:



Ram Pumps

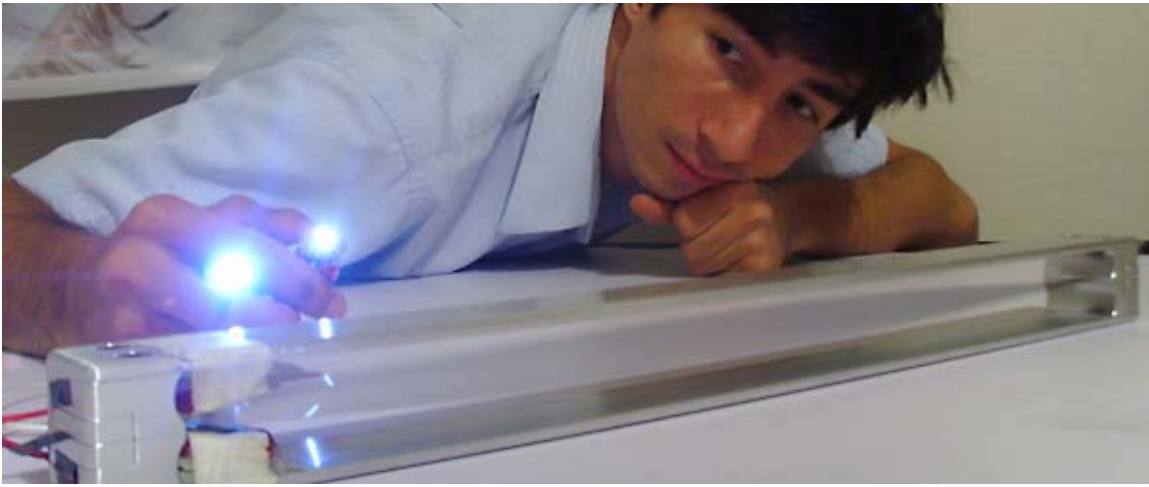
Alternative Indigenous Development Foundation Inc. (AIDFI) has installed 98 of these pumps in 68 communities in the Philippines. These ram pumps pump water from a lower level to a higher level without using diesel or electricity. AIDFI designed a version of this pump that was durable and that relied on cheap locally available materials for maintenance purposes. Locals are trained as technicians and will provide said necessary maintenance. An installation that will serve the water needs for about 300 people will

cost £2,200 to 2,700. This cost has typically been covered by local authorities, NGOs, or governmental development departments.

Source: http://www.ashdenawards.org/files/reports/AIDFI_2007_technical_report.pdf

Wind:

Windbelt



“About the size of a cell phone, the final Windbelt prototype employs a taut membrane that, when air passes over it, vibrates between metal coils to generate electricity.” The company Humdinger energy has started pilot programs in Guatemala and Haiti along with a rapid prototyping facility in Hong Kong. This technology is obviously not quite ready for widespread use, but it is interesting look at what is to come in the near future for wind technology. It is small and seemingly inexpensive. This device was a Curry Stone Design Award Finalist and won the Popular Mechanics breakthrough award for developing countries.

Sources:

http://www.businessweek.com/innovate/content/oct2008/id2008106_231604.htm?campaign_id=rss_topStories

<http://www.humdingerwind.com/#/home/>