$19.95

CAPTURING FREE SOLAR ENERGY AT LITTLE OR NO COST

SUNSHINE TO DOLLARS

Steven E. Harris
www.StevenHarris.net
www.KnowledgePublications.com

Fast, Easy, Visual Solar Heating, Cooling, Cooking and Experiments

Energy is Life

About this E-book.

Congratulations, and thank you for your purchase of this book. The book has been published and in circulation since January 3rd of 2002, and it continues to grow each month.

The book started from the photo documentation of my professional solar, hydrogen, biomass and other energy work. Consulting in these fields is what I do for a living. As I continue to do experiments and development work that are relevant to the home experimenter and enthusiast, I add to this publication. Coming up in a future version is the manufacture of ICE from purely chemical methods regenerated by solar heat. I'm NOT talking an ammonia absorption system, either.

Don't worry. People purchasing THIS version of the e-book will get the updates and upgrades at a very reasonable upgrade price.

This current version of the book has just added very efficient ice making to it, as you'll see later in this book. This is actually one of the easiest ways of making ice. It can be very low in power and very efficient, while other methods are significantly LARGER.

We have a full inventory of solar and hydrogen learning materials at: http://www.KnowledgePublications.com

This includes video DVD's on Hydrogen, Fuel Cells and Electrochemistry. This book, of course, is copyrighted, and you are NOT allowed to sell, duplicate or transmit this document to other people who have NOT paid for the book.

I've spent 20 years of my life in education In this business, and that is not free. I DO LOOK AND SEARCH and chase down those who distribute this book illegally. The Digital Millennium Copyright Act has made this much easier.

Contents

Title Page

Dedication & Preface:
To Judy A. Harris.

This book is dedicated to my mother, Judy A. Harris, who has shown me since childhood that one person's waste is another person's treasure. All through my childhood, we would take what others would discard and give it to those in need: 100-pound bags of beans from farmers in Michigan, crates of slightly overripe fruit from the produce store, three-day-old cookies from the bakery, and much more. We would pick up these items and personally deliver them to a single mother who was just barely making ends meet, an 80-year old lady who could not afford fresh fruit on her social security, *to people who had less than nothing, and to people who were only missing a little something.* Mom would take the cookies and horse-trade them to other people for physical items that were not going to be thrown away. Free cookies were used as barter to get needed items.

There are tens of thousands of donated baby quilts and comforters covering infants and children around the world who are sick, in the hospital, or terminally ill because Mom would get material (cloth) donated, found or contributed. We would drop it off to old ladies and other people who had nothing to do, and in many cases, were house bound. These people relished the opportunity to again have a duty and a method of contribution. Mom and the ladies still do this independently, as well get together every Tuesday (without fail) to have a large quilting bee with twenty or thirty people, and many times more. Material that would have been waste is keeping people warm around the world. People who were alone now have community, and minds that would atrophy now have something to occupy thoughts and something to look forward to every day. This is what free material can do; sometimes, it is more valuable than gold. There is a secret to getting free material for your efforts. This book will share some of these methods with you.

This book is NOT about dumpster diving or trash-picking. Our best practices are much simpler, easier and cleaner. All you have to do is ask. If you are afraid to ask someone to save something for you when they are going to throw it out, then return this book right now for a refund.

You would be amazed what happens when you ask. What's the worse they'll say? It is no.

When you ask, the world opens up.

Companies who install new windows have to haul the old windows back to the shop, after which the glass is thrown in the dumpster. The glass company has to pay for the dumpster to be emptied. By giving you the old glass, they save on dumpster fees.

It is in our nature as humans to help. Most people would be happy to save items for you if they will be used for something. Most people get a joy from giving, even if what they are giving away is deemed useless to them. They know you see it as a treasure.

There are high school teachers who have read this book who are getting free glass for solar ovens for teaching physics. There are Boy Scout troops making solar ovens for almost nothing, and there are people doing experiments and learning in this exciting field of energy because they can now obtain the necessary items for experimentation and learning.

The world opens up when you ask. Thanks, Mom.

About The Author

Steven E. Harris
Photograph courtesy of May Kearny

Steven Harris is a consultant in the energy field. He serves as Director of Operations and Technology for the American Hydrogen Association in the Midwest. After spending ten years in the Aero-Thermal Dynamics department of the Scientific Labs of Chrysler Corporation, where he was a pioneer member of the group that developed and implemented successful Speed-to-Market development concepts, Mr. Harris left his position to do full time work on the development and implementation of hydrogen, biomass, and solar-related energy systems.

Mr. Harris is currently working with Roy McAlister and others on Project Destiny, a solar hydrogen energy system. He is authoring an upcoming book, "The Positive Promotion of Hydrogen Energy, a Model for Success in an Economically Driven Market."

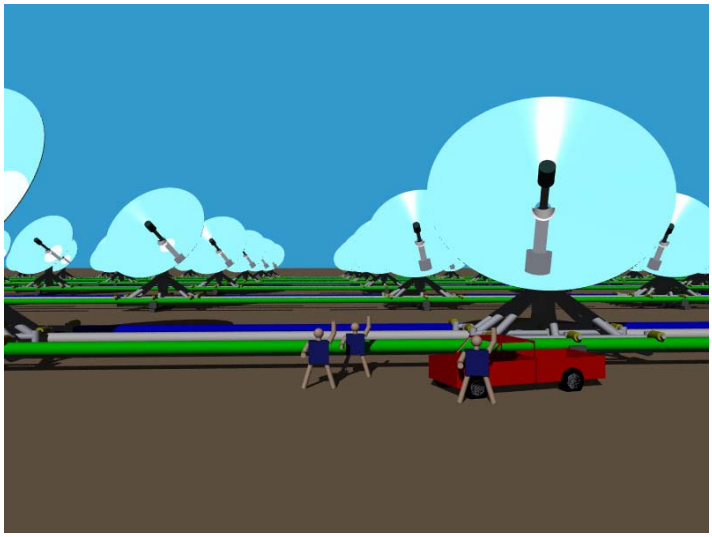
In addition to energy, Mr. Harris has a life long commitment to civil defense and the preparedness and protection of the American public. He teaches family preparedness and education regarding threats to the population.

Mr. Harris's Experience, Projects and a Consulting Portfolio can be found at:
http://www.StevenHarris.Net.

Project Destiny

- Solar photons to electrons through hydrogen.
- 95% off the shelf.
- No photovoltaic panels, no fuel cells.
- Made with aluminum, glass, iron, steel, copper, plastic, and ceramic.
- 100- year-old technology with 21st Century science, methods and manufacturing.

Contact Steven Harris at:
h2fuel@mail.com



Why Waste is Good

There is no advancement without waste. There must be the ability to test something and break it. The ability to make mistakes in development work is where discovery is made and improvements forged. Without the ability of having a surplus of material so multiple versions can be developed, compared, and analyzed side by side, there IS no advancement. For example, if a person has ONE of something, they are not going to do experiments with it and risk it being lost. If sand were as scarce as gold, transistors would have never been invented, let alone developed to the state they are today.

This philosophy is good for modern development work and engineering, such as designing vehicles, computers, and even the silicon in the chips in everything that is around us today. It also applies to the home experimenter in you. Why haven't you done solar experimenting on a large scale, for perhaps your entire house? The answer is probably because of the cost of glass. "What size do I get? Do I need two pieces? When it expands from the heat, will it break? I really want a big oven, but that has $200 in glass alone, etc." We are always finding reasons NOT to do something. This book is going to show you how to get enough glass and other free items to build a solar oven, NOT one that is one foot by one foot, but FOUR FEET by EIGHT FEET.

There will be more than enough glass to waste, break, drop, or to make mistakes with. In doing my research for the writing of this book, I lost about one in every ten pieces of glass for various reasons. The glass was broken either in hauling, moving, experimentation, or by the neighbor kid (Anthony and his slingshot). Once, I accidentally left a double piece of glass lying on a black metal surface in the sunshine. Well, the sun heated the black metal, which heated and expanded the first layer of glass that was in contact with the hot metal. That piece of glass expanded at a different rate than the second layer of glass and...well, when I came back from Home Depot, I had a shattered pieces of glass on my hands. Oh well, I have twelve more pieces just like it, and I just learned something :)

Some of the biggest businesses were started from someone else's waste product. Back in the early 1900's, "gas" for cooking and lighting was made in a steam reformation process of coal. This made carbon monoxide and hydrogen gas (for more on this, get the Hydrogen & Fuel Cell Video at www.KnowledgePublications.com). The process was not as high in temperature as run it today. It also formed byproducts, most of which was a sticky, stinky, black mess called COAL TAR. This was something the gas companies had to pay to have hauled away. This coal tar was a treasure trove of chemicals, one of those being just what was needed for the manufacture of red dyes. At that time in history, a red dye was hard to make and very expensive. Well, a small company started using the coal tar to make dyes, other pigments, and then a whole family of chemicals, resulting in the company's growth. Maybe you've heard of the company, The BASF Corporation.

I could fill this book with examples of businesses that were started from another companies' waste, but this book is about using waste to gain knowledge through experimentation as well as to make solar energy related items, many of which can be sold, and all of which are fun.

Remember, waste is good. Next time you see waste, look at it as an opportunity to make something else, an opportunity to make money, and an opportunity to learn (and have fun).

This Book, Solar Energy and the Future of Energy

What is the future of energy, and what is it going to look like? Where should a person study and learn to be a part of the energy future rather than a participant.

People ask me these questions all of the time. I have been deep into the energy business for many years doing experiments, development work, and very focused on the subject of energy. I understand the role of energy in human life. I know the history of energy and invention and the human spirit, and the instinct to drive forward and improve. I understand energy from 8000 years ago to 500 years into the future. I've worked on many confidential research projects regarding energy, and what could have been done 100 years ago, 40 years ago and what we can do today. And not only what we can do today with our engineering and manufacturing, but what we can do tomorrow and a few years from now. If you knew what I know right now, you'd be staying awake all night like an excited child who just saw Star Wars for the first time. The possibilities are endless. I'll be sharing a little secret with you in this book.

This book is very low tech. It is a hands on, how-to-do-it-in-your-backyard, book. For those who want to be a part of the excitement of the future energy business, then this book is a better primer and instructional tool than all of the current, fancy $100 books. They discuss long formulas and have discussion about fuel cells and new generation photovoltaic and other items on the front page of Popular Mechanics.

The real future of energy is not Proton Exchange Membranes (PEM) powering vehicles and homes, or Solid Oxide Fuel Cells (SOFC), and it sure as heck is not solar cells on roof shingles (what a failure). The strength we have in year 2003 is not the new technology. It is our ability to do mass manufacturing with world-class economics. In our wonderful disposable society (which is good), we make things faster and cheaper and in greater varieties with newer versions quicker and easier than we ever have before. It is only through mass manufacturing and 21st century material science that we will make solar energy so affordable that it is actually disposable. Imagine a disposable solar energy device.

The future of energy is not in hard-to-make membranes for expensive fuel cells and one billion dollar solar cell manufacturing facilities. Here's the little secret...the future of energy is made of iron, steel, aluminum, copper, plastic and glass. We know how to mass manufacture these items cheaper and faster than at anytime in history.

This certainly does not sound as sexy as the stuff that Popular Mechanics uses to put on their front page. All they care about is selling magazines, and most of their writers are English and Journalism majors. The articles are dumbed down to the lost, common reader.

What is the future of energy? It looks like many of the items in this book using wood, metal, glass and plastic, and using the sunshine that is falling on your head all day long. This book contains the fundamentals that you must understand to be a future player in the energy field.

The items in this book are mass manufactured in such quantities that most of the items get thrown away. The smart person can get glass, wire, wood, metal, and more, for free. A 20-year old glass door will work as good as a new piece of glass for a solar heater. All you have to do is hose it off and maybe clean the inside.

These are the fundamentals and YOU can LEARN them YOURSELF in your yard. This does NOT require going to college or buying expensive books or expensive equipment. If a person wants to be in the energy field, it is incumbent upon that person to teach himself or herself.

This is 100 to 200-year old technology that we can use to make energy today with 20th and 21st century materials.

My objective with this book is a hope that the reader can start learning and experimenting with energy TODAY instead of reading Popular Science magazine and dreaming about working with energy.

FREE SOLAR PANELS

These panels cost me absolutely nothing, that is, free. I just hauled them away. How? Where? This is one of the reasons you bought this book, right? Have you seen flashing “arrow” signs on the highway near road construction? Many of these are solar powered. The alpha numeric signs that flash words and numbers are also solar powered. These bulbs used in the sign to make the flashing arrows used to be powered by diesel engines, such as the Lister diesel engine. Now these signs are powered by solar panels, large batteries, and LED based illumination. A simple "arrow board" trailer typically has two 55-watt Siemans panels on it with two or three “8D-sized” lead acid batteries. Each battery weighs about 200 pounds. Imagine this heavy trailer with six hundred pounds of batteries, several hundred pounds of metal, being hit by a drunk driver (BOOM). Well...it happens all the time. Drivers hit these things on a VERY regular basis, especially during the wintertime. The panels end up getting “cracked.” Actually, the glass laminate on top of the polycrystalline solar cells gets cracked while the cells themselves are typically okay. Thousands of cracks will run around on the surface of one panel making the top of the solar panel “less clear.” Thus, the glass absorbs some of the incoming solar light, which gets turned to heat rather than striking the solar cells. These panels that were 55 watts when new now put out 15 to 25+ watts for me in the Michigan summer sunshine. But, they were free. When NEW (2001), each 55-watt panel costs $230-$330. My cost for the fractured panel at half-output was $0. In October of 2002, I had over sixty panels like this. That's free energy. As you drive down the highway and see these arrow boards, take note of the names of the company on the arrow board. These are generally NOT owned by the state, and those are generally NOT state workers out there. The workers you see are a contracted construction company and they RENT the arrow boards from a rental company. Approach the rental company and ask them to save the broken solar panels for you. They normally throw these in the trash. The insurance company for the construction company will pay the rental company for the damaged panels.

A friend of mine and I put ten panels on a frame made of 2x4’s, and we wired the panels up. Three men and myself manhandled this up a ladder and onto my roof. We should have only put five panels on a frame rather than ten, as it was a little heavy. Nevertheless, after a few screws, a bunch of wire, and some wood, I now had free electricity on top of the house. The panels feed into a battery bank in the basement, which is connected to a simple 1750-watt modified sine wave inverter. I do the charge controlling manually. With these, I power the lights and the fans in my basement. I do this typically during the daytime when I am

down there working. Sometimes when it is hot, I just hook up the solar panels to the 12-volt blower in my homemade "air conditioning" system. If I add a good trace inverter/charge controller to the system, wire it into my house box, and put up some more of the solar panels, I'll have a nice system. I still have about forty more panels to put up. The wiring and the frame take time. Half my house is shaded from 1PM to 7PM by a big tree, but that keeps the house cooler in the summer. As you read this book, you will find that most of my solar work is in areas OTHER than photovoltaic (PV). The only reason I have these up is because the panels were free, plus I like to have panels up catching sun that I can use for charging batteries used other experiments I am doing.

I've frequently said that I think photovoltaic solar panels are the WORST thing that ever happened to the solar energy field. It seems people thought this was the "nirvana" and the "pinnacle" of solar energy that could be reached, but no one bothered to do the math. PV panels take ten to fifteen years to pay back their money. Also, consider the amount of electricity it took make the silicon. Regardless of the faulty articles some solar power magazines have put out, a 6th grader can calculate the Return-On-Investment numbers. There are more inexpensive ways of making electricity with solar energy, and there are ways that are far more efficient. The inexpensive ways are typically less efficient, but are made of nothing but iron, steel, copper, aluminum and other mass manufactured components such as pipes and tubing and glass or plastic. The solar-based systems that are very efficient typically involve extremely high temperatures beyond the abilities of metals. For an in-depth discussion of this subject, see my other book, *The Positive Promotion of Hydrogen Energy, A Model for Success in an Economically Driven Market*. When it is available, it will be at KnowledgePublications.com.

Sunshine to Dollars is NOT going to be the typical solar energy book you read. This book is going to SHOW YOU HOW to do experiments around YOUR house with simple tools and inexpensive or FREE materials. This book will ENABLE you, not just tell you about things you can only dream about or are out of your reach. It is the authors' opinion that the largest value from this book is the FREE GLASS that can be easily obtained. Even free solar panels won't lower your electricity bill. There is still a charge associated with getting an inverter and with the life cycle of storage batteries. Making a solar heater and blowing hot air in even ONE room directly reduces fall/winter/spring-heating bills. Batteries for solar electric systems must be replaced approximately every five years, and cost hundreds to thousands of dollars. Glass, wood, and insulation in a solar air heater can last for twenty to fifty years and cost only a few dollars. Every major solar project in the world has failed due to poor economics and principle. Don't let your home experiment fail for the same economic reasons.

These are the highway construction “arrow boards” I am referring to. This one is folded over for transport, and the solar panels that normally point straight up can be seen. These are two 55-watt Seimens panels. These panels are okay and working fine. I'm waiting for a drunk driver to hit this so I can get them for free.

GET THE PANELS BEFORE I DO!!

This is my pickup truck loaded with about 25 solar panels. Some of the panels are bent, and all of the panels have a cracked laminate on top of the solar cells. All of the panels DO work and will output energy in the sunshine. One of the alpha numeric highway signs can be seen in the background. These larger signs have six 80-watt Seimens panels and about twelve Trojan six-volt “golf cart” batteries. I've not seen a drunk driver hit one of these yet. If one does, he'll get what he deserves, and I'll get a bunch of free solar panels and maybe some free batteries. The guys who run the sign rental company will be getting some hot corn bread and beer when I show up to get the panels. It is always good to show our appreciation to the people who are saving the panels for you. Something fresh and delicious goes a long ways and is always appreciated.

FREE GLASS

(the best value in this book!)

FREE glass can make solar ovens, solar water heaters, solar hot air heaters, and anything you want solar. All this glass is double insulated (two sheets), tempered safety glass, and it is all free. If I can get all I want, so can you. I looked in the yellow pages and called some glass and window companies. Several were ALL TOO HAPPY for me to come pick up the glass. This saves them from paying for the dumpster that the glass goes into. Since I work for a non-profit organization, I even offer to give them a receipt for tax donation purposes. Many of them just don't want to bother with it, but are glad to get rid of their glass. They set the glass aside for me and I come by at least once a week and pick it up. If someone is going to save glass for you, make sure you stop by and keep it out of their way. When they call and say, "Come get the glass," you get over there fast and get it. I prefer to get the glass that was removed from sliding glass doors. These are typically 34" x 76" and have two sheets of "safety glass." Safety glass is hard to break unless you hit a sheet on the edge. When these do break, the sheets break into 'rock salt' sized shapes and are easy to sweep up. They don't break into large shards that will act like a guillotine and cut your hand, arm, leg, face or body. The glass in the photo (bottom right) in wood frames is also double insulated glass. This makes it easier for me to include these in experiments because I have wood I can screw into, making the pieces are more manageable. The free glass I get is not "perfect." Many times, the glass is slightly fogged due to moisture getting in between the glass sheets because of a seal failure. That doesn't bother us in a solar heating system. The solar heat will quickly drive off any water in the glass, and a little silicone will plug any holes after the water is driven out. Right now, I have enough free glass to cover my entire roof if I so desired. Further chapters in this book will show the glass being used for passive solar heating and for a solar oven.

FREE MIRROR

I got all the free mirror I needed from one glass supplier. The mirror was to be used for brand new condos and the sheets had a few very, very faint scratches in the surface. This was unacceptable for a $300,000 condo, but as a reflection surface for a passive heater, this is great. I got 1/4" plate mirror, but all kinds can be found for free. I would suggest using a thinner glass mirror, as the 1/4" stuff is heavy, and is NOT safety glass. You can easily get cut if it breaks. I got over 200 square feet of mirror for free from one glass supplier.

Wear SAFETY GLASSES and USE GLOVES. Don't be afraid to ask the glass guys EXACTLY how to handle, move, and cut the glass. Learn from the best.

These doors will be turned into outstanding solar ovens for baking bread and cooking other items. The glass will be at a forty-five degree angle to the sun, reflectors will be off the top and the bottom, and the walls will be made up of the free foam core doors and foam core door knockouts pictured in this book.

These glass doors can also be used in a “flat” box type solar oven as documented further in this book. Again, the wood around the glass makes it very easy to attach a reflector on hinges or the wood of an insulated solar oven.

Other framed, double pane, insulated window glass is seen on the bottom left of this photo. The doors are double-sheet, tempered safety glass. These doors would cost over $200 each. The glass is over $100 if bought new (if not more). These six doors were FREE and will make great solar heaters or ovens.

I got all this glass in one day. It took less than thirty minutes to drive to the glass shop, load the glass, drive home, and unload it. This is not the same glass pictured on preceding pages. This is additional glass, and there was much more on the way at the time I was writing this book. I currently have enough glass to cover my entire roof with solar heating. This glass is being used to make the greenhouse enclosure for the front porch documented in this book.

"...and its available for free…if you go at night."
This is the punch line to the old joke, but this is no joke. I got everything you see loaded on the back of my pickup truck all for free, just for the asking (not going at night). I got all this in one day and it took less than thirty minutes of effort. Included in the haul of treasures are two 1800-psi CO_2 tanks. I can use these for storing natural gas, hydrogen, air, or any other gaseous products. The next most inexpensive brand new tanks would be SCUBA diving tanks that are about the same size but can be rated up to 3000 or 3600 psi.

The satellite dishes came from a company that installs DIRECT TV. Ask your local Circuit City and Radio Shack what company installs the dishes they sell. Approach that company and ask for junk dishes. I got the CO2 tanks from someone who moved into a new building and discovered the old tanks in there. They threw the tanks out.

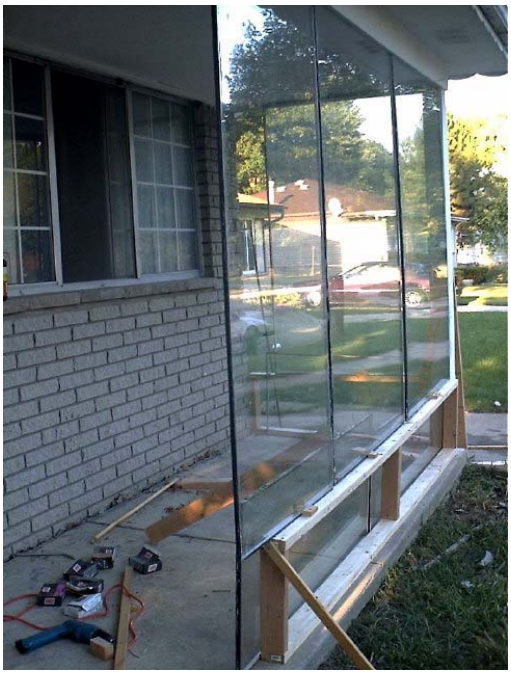
I have six "broken" solar panels that will output half their energy. This was from the road sign rental company that rents signs to road construction crews (see previous chapters). I have six 18" satellite dishes with the metal dish and the supports for the LNB and the roof mounts. The dishes will be coated with a reflective surface (aluminum foil works) and used for solar concentration. The mounts make it easy to mount the dish, a solar panel, a passive solar heater, or solar oven on a wall or a flat surface. This makes it easy to point the solar collector up and down or side-to-side directing it towards the sun. I have three large pieces of insulated safety glass for solar ovens or solar heaters, and I have about five smaller pieces of the same type of glass. This glass was removed from houses when a local glass company installed new glass. The wood frame around the glass actually makes it easy to attach and mount the window to whatever solar experiment or invention I am working with. The glass had a thin film tint on it, but a sharp knife and a can of $1 carburetor cleaner took the film and its adhesive off the glass in just a few minutes.

WHAT TO DO WITH ALL THAT GLASS

This is a marked up photograph of the front and side of my simple little house. I have drawn in lines of where I am going to build a 'greenhouse' type of appendage onto the house. I will start by enclosing in about three fourths of the front porch with glass. For this I am going to use the sliding glass door glass I got for free. I'll make a simple custom frame for the front porch with two by fours and one by twos to hold in the glass. The system will be modular and bolt together such that I can take it down with about 30 minutes worth of work in the late spring. I am NOT doing this as a permanent addition for several reasons. I don't want to have to go get permits and such and this is an EXPERIMENT. I will have temperature probes and data recording devices monitoring the weather, the sun shine and the temperature in the 'green house'. This will allow me to make improvements and additions to the front greenhouse. The concrete porch will server as a crude heat sink and I'll use a blower to move air from the house into the greenhouse on the porch, the hot air will then enter the front window and move into the house. I have lines drawn on the front of the house (the part that is not the porch) and I could put a simple green house there, however I don't think I'll make something that large. I might make two or three solar hot air heaters from two or thee sheets of glass, but these will be below the windows and above the bushes.

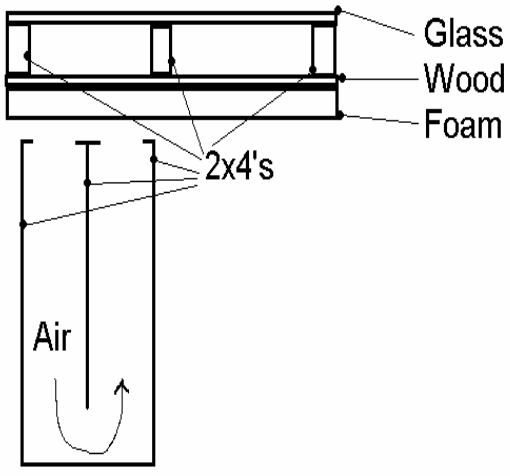
The shingles on the southern part of the roof need replacement soon. Right now half the bad area is covered with PV panels I got for free and the other half will be covered with glass as part of a solar hot air heater. I think glass will make a better roofing material than the shingles. Also, the tempered sliding glass door glass can take one heck of an impact so it should be VERY resistant to hail. We have taken a hammer and beat the middle of the tempered glass sheets. It took 6 hard hits before the glass shattered. ONLY TEMPERED glass will behave this way. Regular glass will break with a very small impact, be careful!

A solar oven and air heater will go into the window where the air conditioner is just above and to the right of my pickup truck.



If you live in a glass house, don't throw rocks. I am glassing in part of the front porch, making it a small greenhouse. With the double wall insulated glass, it got warm quickly allowing hot air to enter the house. I was unable to complete this the way I wanted to because the city wanted a permit for the construction. The permit price was based on the cost of the construction, which was $18 for new 2x4's. The inspector could not believe I got all of the glass for free and how low the whole thing cost. I decided this was more of a headache than I needed at the moment in my neighborhood, so I elected to take down the glass porch. It took less than 30 minutes with a power screwdriver. Less than an hour later, it was as if it were never there. As I mentioned before, it was modular and intended to be put up and taken down with ease and not as a permanent addition to the house.

I ended up making a simple hot air heater for the front southern window. The photos show the heater without the insulation on the in and out air ducts. The air ducts are the aluminum tubes used for cloths dryer venting. The glass is free. The back of the heater is 1/2" plywood painted black, and there is a piece of two-inch foam behind it attached with liquid nails. A frame of 2x4's keeps the glass off the black wood, and a 2x4 runs down the center from the top to about twelve inches from the bottom. The air enters at the top, is blown down the air heater, and comes back up the other side (because of the 2x4 divider in the middle), and then exits the top as it goes into the house. This very crude setup would blow 105F air into the house anytime the sun was shining. There are two reflectors on each side to add more sunshine to the heater. There is a thermostat from Grandier in the middle of the heater. When the air is 100F, it turns on a six inch $20 heating duct blower from Home Depot that moves the hot air into the house. I forgot to plug in the blower one day and the heater quickly got over 200F and melted the plastic on the thermostat <sigh>. There are better ways of making a solar heater but this is a great start and learning exercise.



A Twenty-five Cent Window Solar Energy Heater That Works

www.KnowledgePublications.com www.SunshinetoDollars.com
Steven Harris h2fuel@mail.com

Black plastic taped to a curtain rod over a window

Vertical blinds UP

Sides of plastic are open. Its just a hanging sheet of black plastic

Air gap between the bottom of the plastic and the window sill, only one to two inches

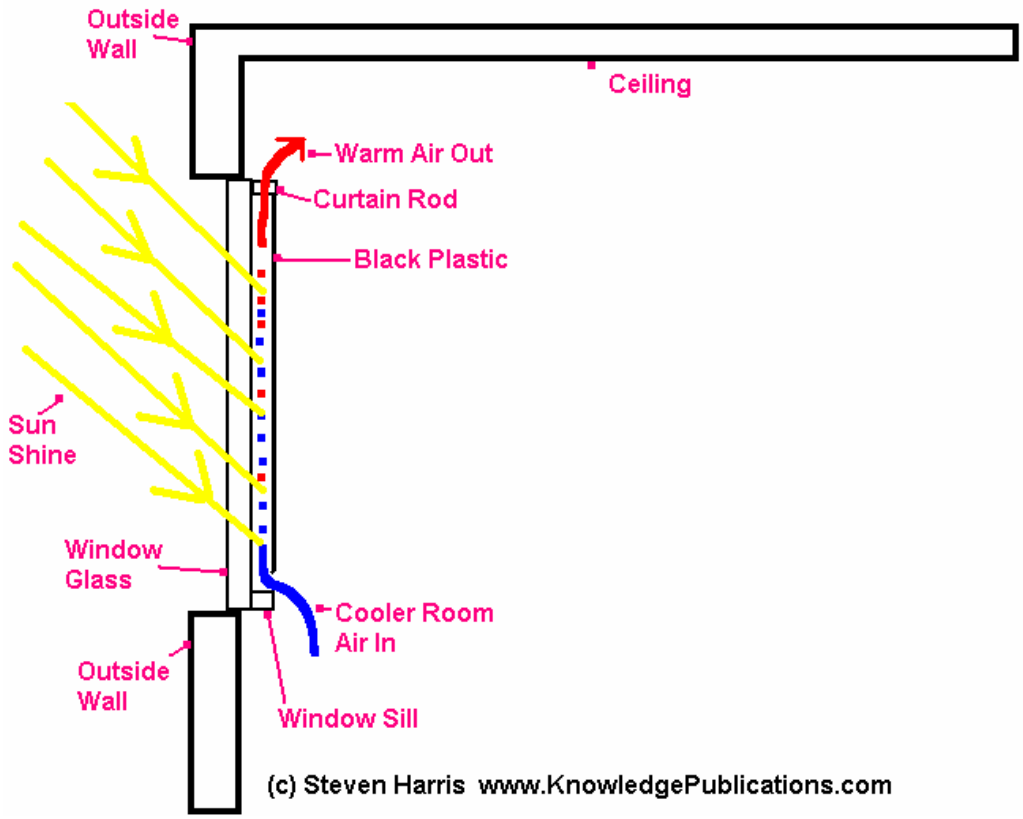
77F air OUT of the top with February sunshine in Michigan

3-Mil black plastic from Home Depot, costing a few dollars per roll

67F Room Air IN the bottom air gap

Inside View

Outside View



WHY IS THIS DIFFERENT?

What is different about this and sunshine just falling into a room? In Thermal Science, it is called QUALITY. Simply put, heat quality is the temperature of the energy. When sunshine normally falls into a room, it will hit the carpet, a desk, a paper, a wall, or a sleeping dog. All of these items reflect, absorb, and bounce the light in a different fashion. Some light gets bounced onto the ceiling where part of the energy gets absorbed and reradiated as heat, while some of it gets reflected to other parts of the room. The black plastic sheet is VERY receptive in absorbing of sunlight, and absorbs most of the sunlight in one limited spot of air between the plastic and the glass. This reduces how fast the heat can get away and allows the air to get hotter (have a higher quality). The black plastic absorbs the ultraviolet (visible and infrared wavelengths of sunlight) that make it through the glass, and re-radiates the energy as long wavelength infrared light. You can mildly feel this on your face when standing close to the plastic. Cool air thermally siphons from the bottom of the plastic, warms up, and moves out the top of the plastic/window air gap. This simple trick noticeably warms the room up, making it feel much more pleasant. The whole window can be blocked with plastic, or only part of it can be blocked to save some of the view.

I used a three Mil, black piece of plastic I got from Home Depot, but a black trash bag will work almost as good.

MORE SUNSHINE = MORE HEAT

With a Word of *Caution*

I added a reflector outside the window to bounce more sunshine into the window. This actually puts "TWO Suns" onto the window, the sun that normally falls through the window and the reflected sunlight. This is called TWO SUNS. If I had a second reflector, this would be a total of "Three Suns" (DO NOT DO THIS). Before the sunshine hid behind the clouds last four days here in Michigan, this reflector quickly got my air out temperatures above 85F, and the sunshine was a little hazy. With my solar oven experience, I think this would of easily gotten over 100F with a February sunshine in Michigan. The reflector is aluminum foil with Elmer's glue on cardboard. I am going to re-do this with flat masonite. Adding a hinge or two allows for easier adjustments (rather than using the displayed brick method.) DO NOT add more than ONE reflector to your unit. When it gets warmer and the sun gets stronger, multiple reflectors *WILL* actually get the plastic so hot that it WILL literally go POOF and up in flames. ONE reflector with REGULAR aluminum foil is more than enough.

It is true that in areas like Michigan, we have a limited number of sunny days in December. However, we have more sunny days in January, February and March, but it can EASILY be well below freezing during these months. Even during April and May, it can be in the forties, fifty's and sixties. I LIKE my house 70F+, and on these days during half the year, this little solar air heater will add gentle warmth that my furnace or wood stove does not have to add. It does it all by itself. I don't have to turn it on. The project can be done in ten minutes, and I can take it down and put it up in seconds. This project can also be done by anyone in an apartment.

Making a 350 Degree, Twenty Loaf of Bread, Solar Oven for $9

This is the metal liner inside an upright freezer. I took the outside walls, mechanical refrigeration and other components off for experiments and was left with just the metal liner.

This is the FREE 34x76 inch piece of sliding glass door glass coming home from the Glass and Mirror company. It is slightly fogged but will work great.

Glass and metal liner for size comparison. It will work.

Paint it black with a $1 can of flat black spray paint from Home Depot.

Finish painting it black. It took four cans at $1 each to paint the whole INSIDE flat black. You do not need to paint the outside. It took about 45 minutes to do the job, and could have been done as well with a brush and black paint from a can.

I put the metal liner on top of the door from the old freezer for insulation. I actually added MORE pink home insulation between the liner and the old freezer door (not shown), as it needed more insulation. Styrofoam from Home Depot/Lowe's is inexpensive and will work. Using a few inches of free cardboard will also work. A variant of a layer of cardboard and a layer of Styrofoam will work. Straw bales and shredded newspaper will also work. The pink insulation I used was free because the bag was ripped and the store could not sell it.

Wanting to see how well the unit might work, I wrapped it in pink insulation and propped it up with some wood and chairs to keep it from falling over. I then started doing temperature measurements to see how hot it would get. Verifying the project as it goes along like this is called good development work.

FREE CARDBOARD, free walls, free insulation. The local appliance store was happy to give me a box of boxes. I couldn't take just one or two...I had to take a whole load. They normally sell things for recycling, but were happy to give a load to me for my experiments. All of the insulation you see in this project can be replaced with cardboard and air spaces. I'd use three or four layers of cardboard with one or more inches of air gaps between the layers to replace the eight inches of double-wrapped pink insulation I used. Solar ovens can be as small as one cubic foot. They don't have to be this big. The free cardboard can be used for making any size solar cooker or solar heater. Just waterproof it with glue and plastic sheeting.

Next, I made a one-piece, three-sided wall from the cardboard, covered with a reflective layer. This can be normal aluminum foil or it can be mirror sheeting. The mirror sheeting will give a little better result. I paid eleven cents a square foot for mine from http://www.mirrorsheeting.com. I used 3M spray adhesive to glue the sheeting to the cardboard. Elmer's glue will also work but does not dry as fast. Spread the glue on, brush it out with a brush, and then lay on the aluminum foil or sheeting material. I could use my free, one-quarter inch plate glass mirror, but it would have been a little heavier and harder to handle.

I also put a wrapping of cardboard around the insulation to keep it from falling.

Nielsen Enterprises:
Hydroponic Gardening/Reflective Films, Mirror Sheeting.
3019 S 256th Street, Kent, WA. 98032
(253) 941-7425
9AM to 9PM (Pacific Standard Time)

The FIRST TEST CAKE (top left). Cake from a box mix ready to go into the oven, and a type K thermocouple meter reading a temperature of 295F. Get a four-dollar oven thermometer from the hardware or grocery store.

Right Photo: The finished cake, forty-five minutes later. The cake normally bakes at 325F. During the first part of the baking, the temperature fell to 240F but came back up. The cake took only a few minutes longer to cook. Solar ovens can take more time to cook than a conventional oven. The positive side is that it is almost impossible to burn something in a solar oven. You hardly have to worry about over cooking.

After the first test cake, I baked five loaves of bread and two cakes at the same time. This time, the baking temperature was about 275F because I added a lot of dough, which contains moisture. Driving off the moisture during the baking process will lower the temperature. However, it only took an hour and a half in Michigan June sunshine to bake these. All were baked at the same time. I estimate I could bake twenty loaves at once in the solar oven, and I could do four or five such batches during one solar day. That means this oven could bake eighty to one hundred loaves of bread in one full sunshine day. I imagine that if I cook two layers of loaves, I could bake almost twice as much. The baking time might extend just a bit and bring my over all numbers down from less than a doubling. Still, a hundred loaves a day, and $10 for the oven is not a bad investment. Start a Solar Bakery.

Complete photo documentation can be found at http://www.StevenHarris.net/solaroven.html
(~34 high resolution photos)

A Solar Oven with FREE GLASS, and Plywood and Foam from Home Depot.
The Wood, Foam, Screws, Adhesive and Metal Brackets cost about $15 in 2002.

We started with a piece of free glass with a wood frame around it. The frame was 24x24 inches, so we cut out a box with half inch plywood. The base of the plywood box is 24x24 inches, and the sides are 24x12 inches high. The oven will be twelve inches deep. At the same time, we cut two inches of foam matching the same sizes as the pieces of wood. This is the insulation. A wood box was made by screwing the sides and bottom together using metal corner brackets for 2x4's used in construction (about fifty cents each at Home Depot). We used sixteen metal corners.

Using a caulk gun and liquid nail adhesive, we glued the foam to the outside of the wood box. The foam sticks very quickly and only needs to be held in place for a few seconds. The foam is the outside of the solar oven. We did not add an additional protective layer. If the oven was going to be moved and transported, I might suggest gluing a layer of one-quarter inch plywood or some other laminate to the outside of the foam as an impact barrier and a layer of protection. Using our oven dimensions, we could build two complete ovens from one sheet of plywood and foam. However, because of this sizing, we could not make the foam larger to make a perfectly covered corner. But since there is so little exposed surface area in the corner of the oven, this will not represent a significant heat loss. Making a solar oven is NOT rocket science, and it is hard to goof. A solar oven is nothing more than a black box with insulation, two layers of glass on the top, and shiny reflectors. That's it. Just make sure to silicon all of the cracks and holes. A solar oven or heater will NOT work very well if there are air leaks.

Aluminum foil on the reflector.

The wood framed glass was attached to the plywood part of the box with a pair of $2 hinges from the hardware store. This enables the top to hinge backwards, but it is not necessary. The solar oven will work just fine if the glass is placed on the top and simply removed when desired.

The reflector operates differently from the oven. The wood for the reflector is not attached or hinged to the solar oven. The reflector just sits on the top of the solar oven and either the entire oven is rotated to track the sunshine, or the reflector is rotated by itself. This needs to be done every thirty to sixty minutes with a solar oven of this style.

The reflector IS hinged, so the shape of it can be changed. The idea is to concentrate the sunshine into the oven from two or three different locations. This increases the concentration of the sunshine and the maximum temperature of the oven.

To stick the aluminum foil or Mylar film to the reflectors to the reflectors, a glue was made from two parts Elmer's glue and one part water. Pure glue or 3M spray adhesive can also be used. When the glue is dry, the solar oven is ready for use. Don't forget to paint the inside of the oven flat black. A $1 can of flat black spray paint will work just fine. Both are available at Home Depot or Lowes.

For a simple and quick cooking experiment, get a can of biscuits or a load of frozen bread dough from the grocery store. To cook the biscuits, just unwrap them, put on a cooking sheet, and stick it in the solar oven. Remove the biscuits when they reach a nice golden brown color.

Too cook the frozen bread dough, let the frozen dough thaw and rise in a bread loaf pan. Then simply put the bread and pan into the oven and watch it bake. This could take twenty minutes to a few hours, depending on your sunshine. I usually bake a loaf in about an hour. Don't fear if the bread is left for too long in the oven. Solar ovens generally will NOT burn what is being baked. Bread is usually baked at about 350F and biscuits are baked at about 425F. Even if the oven is at 250F, both of these will bake just fine.

To make soups and such, just put a dark pot (with no plastic handles) into the oven and put the ingredients in. This will heat up and cook pretty quickly. It is easier to bake soups than it is bread.

Yes, you can even bake a turkey in here if you so desire. Anything that will bake in a regular oven can be baked in a solar oven. Bread, biscuits and cakes are my personal favorites.

USES FOR A SOLAR OVEN.
I have to admit that I think cooking with a solar oven is just plain neat. There is something magical about putting bread out in the sunshine and coming back an hour later and it is all done. No electronics, no controls, and no on or off button...it just works. It is like a magic box, but it is not magic. It is plain and simple science.

TIME SAVER
There are some solar ovens that are built into the side of a house, either on the east or west sides facing south or in a southern wall (in the northern hemisphere of course). But most of us will use a solar oven sitting outside on a table or on the ground. The solar oven can be a time saver because of its "non-automation automation." Since it is very hard to burn anything in a solar oven, it is hard to cook something for too long. If you leave biscuits in the gas or electric oven in your house for three minutes too long, the biscuits get burned. If you leave biscuits for thirty minutes too long in a solar oven, they are just kept warm. It is easy to make up a pot of stew and some pans of cake or bread and simply put all of the items in a solar oven at once. Then, you can go about your business or errands for a few hours and come home to a fully cooked meal (assuming it did not get cloudy).

THIRD WORLD
This is where most of us Americans would say, "Boy, that'd be good in the third world." Well, I've done a lot of work with people in the third world, and they'd be happy just to have something to eat rather than something to cook it in. Most places that need the solar oven the most don't have the resources available to make an oven. Glass can be quite expensive, and often time is just not available. Glass can be heavy and obscure in size, and this makes it hard for people such as missionaries to transport it to a far away place. COOKIT is a great solar oven made out of nothing but cardboard, aluminum foil and a high temperature oven bag. You can see it at http://www.solarcooking.org/cookit.htm.

CIVIL DEFENSE in America.
As I sit here writing this updated page for the revised *Sunshine to Dollars*, Homeland Security Director Tom Ridge is telling us about home preparedness and the Ready.gov website. I've worked in the civil defense field for nineteen years, and have helped and taught many people and families about home preparedness. There is NO substitute for preparedness...none. A little bit goes such a long way when things go bad.

WHAT KILLS PEOPLE, WHY ARE WE ALIVE TODAY?
Why is our world blessed with over six billion living souls today and growing? This is an easy answer...antibiotics and clean water.

Antibiotics are part of the modern medicine that keeps us alive. Imagine dying of a small scratch from a rose bush or the bacterial infection after a viral infection such as a cold. Presidents Washington, Harrison, and Garfield all died of one type of infection or another. Antibiotics and modern medicine, the tools of research and production, all run on energy. Dow Chemical would not be producing much salicylic acid (aspirin) without energy.

Fresh water. It takes a significant amount of energy to move water. Whether it is up from a depth of one hundred feet down in Lake Huron, or one thousand feet down in the desert, or from twenty feet down the earth, it requires energy for pumping. Without fresh water that has been filtered through the soil, we are forced to drink surface water. Surface water with access to sunlight and oxygen is a good place for the growth of bacteria, viruses (in bacterial), parasites and other forms of contamination from fecal matter and other organic waste materials.

Energy for fresh water also implies energy to pump sewage OUT of a high-density population area. A modern city could not exist if there was not energy to pipe water INTO the city and energy to move the human excrement (piss and crap) OUT of the city. We also need energy to pick up our garbage and haul it out. All of these waste products are breeding grounds for bacteria and disease that has plagued and killed man.

What kills most of the people in a large hurricane, a flood, a nuclear detonation is the loss of infrastructure after the event. No power, no lights, no refrigeration, no heating, no water, no sewage, no banks, no ATM's, no delivery trucks, no gasoline, no natural gas, no telephones, no Internet, no cell phones...all this and more kill.

How Does A Solar Oven Help My Family in a Disaster?
It supplies a little bit of the energy that is now gone that kept you alive.

Thirsty? Did you get some water from a lake and don't know if there are little buggies floating in there that will cause stomach problems or an infection? Put the water in the solar oven and get the water to 160F+ for at least six minutes. This will pasteurize the water and kill all but the most hearty of microbes (like what "might" be growing in a swamp). Boil the water boil (212F) in a solar oven for five to ten minutes will kill everything. You can install a distillation column (see elsewhere in the book) attached to the solar oven (like what's on top of a moonshine still), and you can distill off the water vapor, condense it, and the water will be about as pure as fresh rain. Even more, you can distill your own urine. Put a bucket of urine in a solar oven, boil the liquid, distill off the water, and drinking water will be produced. The only thing left will be heavy salt water. Fresh urine is sterile, with no bacteria. The nitrates and minerals in our urine are food for bacterial growth. A bacteriam that gets in there from the air or the container grows at a rapid rate. What happens to a pail of day old, stinky urine (the stink is from bacterial growth) in a solar oven? Well, it will heat up to about 212F, killing all of the bacteria. The water then boils off, is condensed, and used. I should note that this method is also a very excellent method of doing desalination (removing salt) from seawater. Human urine is little more than salt water with minerals. You think whales don't piss in the ocean?

Hungry? Baking is a very energy intensive activity, usually because of the amount of time involved. Dutch ovens use a large amount of wood for baking. A "camping" oven on a burner takes a large amount of energy. Boiling water for soup can take five minutes, while baking bread takes thirty to sixty minutes. Every minute a burner is running is one less minute of fuel you have to run a stove.

Corn bread (add water only mix), biscuits, cake and other baked goods are very inexpensive and very easy to bake, but only with electricity for lights and power for the oven. Without a modern oven, baking uses a lot of precious fuel and energy. Mixing up a batch of (add water only) biscuits using a Coleman oven stove can easily use a half pint to a pint of fuel, that is, if you have the $28 oven, $35 stove, and Coleman fuel at $3 per gallon, or gasoline at $1.50 to $2.00 a gallon and $1 gallon container to hold the fuel.

Fast, Cheap Emergency Food. Take a small box of corn bread mix, add water, mix it up, pour it in a cake or bread pan and put it in a solar oven. When it is golden brown, remove it, let cool, and eat. For biscuits, just add water, roll out about one quarter to one third inch thick, cut it with an upturned cup, place the biscuits in the solar oven, and bake until golden brown. Add peanut butter, jelly, honey or anything else desired.

BISCUITS FROM SCRATCH?
Two cups flour
Less than one cup of water
One half to one teaspoon salt
One tablespoon baking powder
Zero to one half cup sugar

This is really hard tack (which is not hard when fresh). The easy way to remember this recipe is two, one, and one half. That is, two cups flour, one cup water, and a half teaspoon salt. The baking powder makes it puff up (like a biscuit), and the sugar adds calories and is optional. Mix this up, roll it out on a flat surface with a soda or wine bottle, cut it with the top of a cup, and put the biscuits in a solar oven (or regular oven). Eat fresh or let the biscuits dry out. They will keep for years. I have 2+ year old biscuits that are 100% edible. What spoils in food is the oils, butter, and milk products. However, adding oil, milk, powdered milk, or butter to the above recipe GREATLY improves the taste, but you need to eat them within a week of baking the biscuits. Breads with yeast, quick breads, unleavened breads, biscuits, drying meeting, dehydrating fruits, cooking beans, rice and many more items can be cooked with a solar oven. A complete class in preparedness is beyond the scope of this book. We felt the subject was so important, and solar ovens too beneficial to the protection of life in America and abroad, that we added this subject in the book.

Lack of energy kills people. Energy is life. Restricting, legislating regulating, or removing energy whether by government, man, or nature, kills humans.

A Solar Hot Water Heater Made from a Door, 2x4's, Plastic Sheeting, and Glass.

This is very easy. Take one door and put a 2x4 inch frame around the edge ON TOP of the door. Lay down a layer of plastic and pour in fifteen to thirty gallons of water. Cover it with a layer of double-sheet glass, like the glass from a thirty by seventy-two inch sliding glass door.

Make sure the 2x4 frame is the same size as the glass. The door under it can be bigger. In the photos above, I painted the door black and used clear plastic so the frame and construction method would be easy to see. However, I suggest NOT painting the door and just using black plastic sheeting. This is four-Mil, black plastic sheeting from Home Depot. There is about $2 in plastic used in this heater. The corners of the 2x4 inch frame are just screwed together with two three-inch, deck style wood screws. That's it.

WARNING. This water is HOT and WILL SCALD AND BURN YOU INSTANTLY. SEVERE BURNS ARE POSSIBLE ***157.6F Shown on Meter***

Simply lay the sliding glass door over the frame. It seals nicely with the plastic. As the photo on the right shows, this water got to 157F. I routinely get my hot water heaters to 185F in the summertime, and easily get to 140F to 155F in the wintertime. This is done with NO REFLECTORS. If reflectors are added to this similar to the ones on the solar oven, the water will EASILY reach 212F and boil away. This can be a good thing. Using a reflector is also a great way to catch more low angle winter sunshine to make more hot water. Heating a house with hot water is not as efficient as hot air. It takes about three times as many solar water collectors to heat a house than it does with solar hot air. BUT, in many cases, water is easier to work with and move. When your materials are FREE or cheap, the hot water method can be affordable. Don't try this with NEW materials. You will never get your money back.

These two top photos show some improvements on the hot water heater. I used the free door knockouts as additional insulation under the door. The photos clearly show the wood frame and how it was made to fit the glass going on top of it rather than the door under it. Notice the door on the right is NOT black, but white. It does NOT need to be painted if black plastic is used. The right photo shows the two solar water heaters that ran in my backyard for almost a year. Everyday, the water would get to about 180F in the summer and around 150F to 160F in the winter, except when it was cloudy. I put about fifteen gallons of water in each one of these, but each one could hold thirty gallons. To have each one hold more water, just use 2x6 or 2x8 inch material for the wood frame instead of the 2x4's I used. Modify, experiment and write me. Send photos.

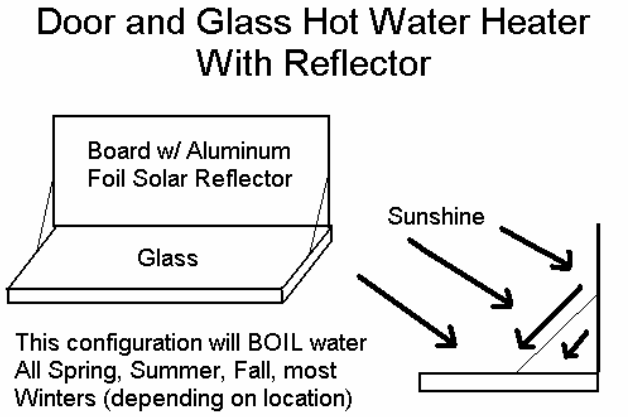
Heating water up to 160F for eight minutes or longer will kill most of the bacteria, spores and parasites in water. Please see the article in this book on the "Solar Puddle," and the section on Civil Defense. Not only can this make hot water, but it can also make water that is safe to drink. This is important for third world applications as well as disaster situations in the USA. Parasites and contaminated water kill more people around the world than anything else. Clean water, septic systems, antibiotics, and plentiful energy are the reasons we have over six billion people on the planet today. Eliminate any one of these items and people die.

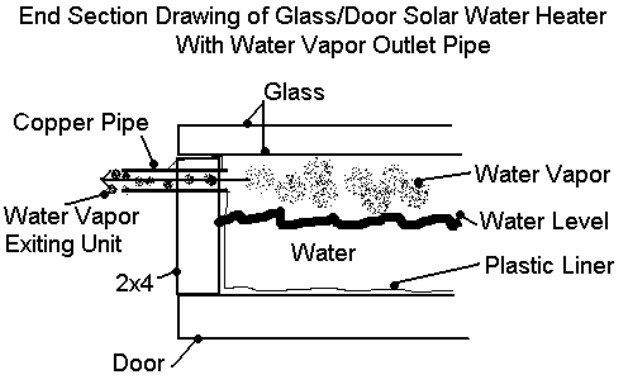
DESALINATION - Salt Water to Fresh Water

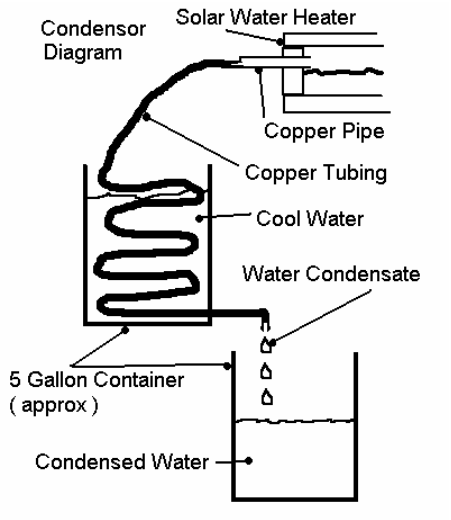
Build it...I dare you. The solar hot water heater on the previous page is about as simple as it gets. Call some glass companies in the phone book and ask for some 34x72 inch "door wall glass" they have removed from a house when they installed a new sliding glass door. Go to the Habitat for Humanity store and get a door for $1. Find one on the curb, buy a used one, or ask the glass company if they have any old doors they removed. Get three 2x4's from Home Depot for about $2 each, and make the solar hot water heater I described. If you do this, and put fifteen gallons of water or more in it, it will be obvious to the person who actually does this experiment that even though the water might only be at 180F, a great deal of water vapor (steam) escapes when the door is lifted a bit. It just shoots right out. It almost burns your hands sometimes (wear a pair of gloves when lifting the glass). To everyone else who just read this book and does none of the experiments, the rapid steam generation will not be apparent.

ONE SUN. On a good and hot summer day with full sunshine in Michigan, the water will get to be about 180F. It is hard to get much higher with just the sun falling on the glass. When the sun is falling on an object, this is called ONE SUN. When the sun falls on an object and a reflector (like a mirror or something shiny), the reflector reflects the sun onto the same object. This is called TWO SUNS. With two suns on the water, the energy input is almost doubled, and the water will BOIL. Yes, it will boil with stream bubbles and everything. This will produce much more water vapor to be distilled and turned into "pure" water. This is the same way Mother Nature produces rain. Evaporation of lake, river and ocean water occurs, then the condensation of the vapor falls as rain, snow, dew, fog or hail (thunk!). The reflector is also a great way to increase the output of the hot water heater, and to give it much better performance in the winter, especially with the low angle of sunshine.

Drill a hole and push a pipe of some sort through the top of the 2x4 and over and around the plastic so it still holds water. Be sure to use silicon caulk to seal the pipe and hole. Otherwise, the water vapor will leak out and not go into your condenser tubing. This output tube can be PVC, copper, iron and even some other types of flexible tubing (garden hose). The condenser would work best if it was copper, but even plastic tubing will work. The job of the tubing is to give up the heat of the water vapor and thus condense the water. If plastic is used, more of it will be needed. If a water cooler is not used, then more tubing in the open air will be needed. This page is not a "how to," but illustrates the *principles* to follow for making a desalination unit. *Get the water hot, get the vapor out, cool the vapor, and drink the water.*







http://www.solarcooking.org

Solar Cooking International is really an outstanding organization devoted to helping promote solar cooking around the world. This wonderful organization seems to be free from political and environmental motivations, and just dedicated to the helping of people. Their website is a wealth of plans, drawings, photos, and descriptions of solar cookers people have made around the world. This is an excellent place to get free information on solar cooking (which is a close cousin to solar heating). With the free glass, mirror and cardboard sources we have outlined in this book combined with the documentation on this website, there is no end to the number of projects and experiments that can be done for education and experimentation, even to the extent of starting of very valid businesses. Make sure you look at the "Cook It" solar oven. It is 100% card board and aluminum foil, and can be made in an hour.

http://www.solarcooking.org/cookit.htm

http://www.ece.vill.edu/~nick

Since about 1995, Nick Pine has been answering any and all questions regarding heating, cooling, energy, and especially solar energy for heating and cooling through his "Nick Pine" web page and Usenet postings. His form and style of writing, and his explanations of mathematics, are nothing short of role model in quality. His archive of Usenet (newsgroup) postings on his website is a treasure trove of solar energy advice. Solarcooking.org will help you make a box that gets hot. Nick Pine's info will help you take a box that gets hot and use it to heat your house. Anyone who really wants to learn solar energy/energy/thermodynamics and more would be a lazy fool not to read everything Nick writes on a regular basis.

Nick Pine's email tagline describes himself as: Computer simulation and modeling. High performance, low cost, solar heating and cogeneration system design. BSEE, MSEE. Senior Member, IEEE. Registered US Patent Agent. Web site: http://www.ece.vill.edu/~nick

http://www.redrok.com

A great website run by a great and crazy guy who loves high temperature solar energy and many things associated with it. Duane's site is a large database of subjects with a large list of links to every energy subject you can think of on the web. The links are well maintained, and removed and updated on a regular basis. I only have THREE links to anyone else in this entire book on the subject of solar energy. Do you know why? They are the only ones that are really worth a darn. They're here for their extreme EXCELLENCE.

Wisdom that Clemente Mesa taught myself and many others.

For all of you kids in school, college, or out of college, your learning JUST BEGINS when you leave school. It is not the end of learning; it is just the start. ***Learning is a personal exercise that is to done DAILY by the individual***. It is up to YOU to teach yourself, to BUY your books, to take classes, to try experiments. This is on YOUR TIME. It is NOT the duty of your company to fund your education or books. It is YOUR DUTY to YOURSELF to do this. Everyday the gazelle must wake up and run a little faster to keep ahead of the lion. Every day the lion must wake up and run a little faster to catch the gazelle. One of these animals is either going to get eaten or is going to starve. Education, industry, and science are the same way for YOUR position. Evolve or die. Learn, or get replaced by someone better.

The Solar Puddle

A new water pasteurization technique for large amounts of water. *By Dr. Dale Andreatta, Derek Yegian*

The lack of clean drinking water is a major health problem in the developing world. To reduce this health risk, ways of producing clean water at an affordable cost are needed. People need to be educated about germs and sanitation, lest they accidentally re-contaminate their clean drinking water. Recently, several of us at the University of California at Berkeley have attacked the first of these requirements. Previous issues of this newsletter have included stories about our water pasteurization indicator and our flow-through water pasteurizers based on a design by PAX World Service. In this article, we describe a new low-cost device that pasteurizes water.

For those not familiar with the pasteurization process, if water is heated to 149° F (65° C) for about six minutes, all the germs, viruses, and parasites that cause disease in humans are killed, including cholera and hepatitis A and B. This is similar to what is done with milk and other beverages. It is not necessary to boil the water as many people believe. Pasteurization is not the only way to decontaminate drinking water, but pasteurization is particularly easy to scale down so the initial cost is low.

The new device is called a solar puddle, and it is essentially a puddle in a greenhouse. One form of the solar puddle is sketched in the figure on the following page, though many variations are possible.

One begins by digging a shallow pit about four inches deep. The test device was a "family-size" unit, about 3.5 by 3.5 feet, but the puddle could be made larger or smaller. If the puddle is made larger, there is more water to pasteurize, but there is also proportionately more sunshine collected. The pit is filled with two to four inches of solid insulation. We used wadded paper, but straw, grass, leaves, or twigs could be used. This layer of insulation should be made flat, except for a low spot in one corner of the puddle. Put a layer of clear plastic and then a layer of black plastic over the insulation with the edges of the plastic extending up and out of the pit. Two layers are used in case one develops a small leak. We used inexpensive polyethylene from a hardware store, though special UV stabilized plastic would last longer. Put in some water and flatten out the insulation so that the water depth is even to within about a half inch throughout the puddle, except in the trough which should be about one inch deeper than the rest. Put in more water so that the average depth is one to three inches, depending on how much sunshine is expected. A pasteurization indicator (available from Solar Cookers International at 916/455-4499) should go in this trough since this is where the coolest water will collect. Put a layer of clear plastic over the water, again with the edges extending beyond the edges extending beyond the edges of the pit. Form an insulating air gap by putting one or more spacers on top of the third layer of plastic (large wads of paper will do) and putting down a fourth layer of plastic, which must also be clear. The thickness of the air gap should be two inches or more. Pile dirt or rocks on the edges of the plastic sheets to hold them down. The puddle is drained by siphoning the water out, placing the siphon in the trough and holding it down by a rock or weight. If the bottom of the puddle is flat, well over ninety percent of the water can be siphoned out.

Once the puddle is built, it would be used by adding water each day, either by folding back the top two layers of plastic in one corner and adding water by bucket, or by using a fill siphon. The fill siphon should NOT be the same siphon that is used to drain the puddle, as the fill siphon is re-contaminated each day, while the drain siphon MUST REMAIN CLEAN. Once in place, the drain siphon should be left in place for the life of the puddle.

The only expensive materials used to make the puddle are a pasteurization indicator (about $2 for the size tested). All of these items are easily transportable, so the solar puddle might be an excellent option for a refugee camp if the expertise were available for setting them up.

Many tests were done in the spring and summer of this year in Berkeley, California. On days with good sunshine, the required

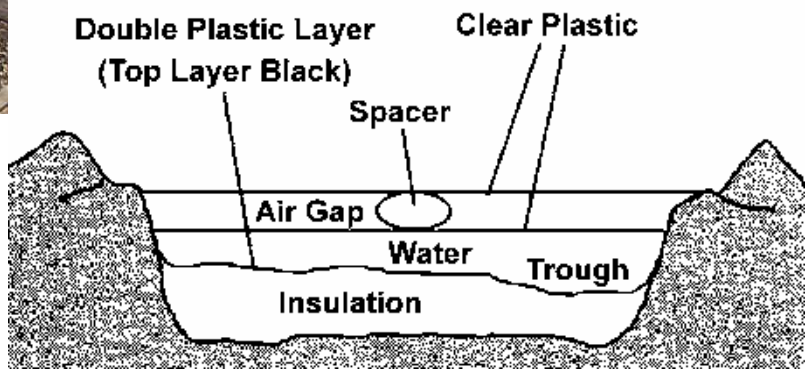
temperature was achieved even with seventeen gallons of water (two and a half inch depth). About one gallon is the minimum daily requirement per person for drinking, brushing one's teeth, and dish washing. With thinner water layers, higher temperatures can be reached. With six gallons (one inch depth), 176° F was achieved on one day.

The device seems to work even under conditions that are not ideal. Condensation in the top layer of plastic doesn't seem to be a problem, though if one gets a lot of condensation, the top layer should be pulled back to let the condensation evaporate.

Small holes in the top layers don't make much difference. The device works in wind, or if the bottom insulation is damp. Water temperature is uniform throughout the puddle to within 2° F.

After some months, the top plastic layers weaken under the combined effects of sun and heat. They have to be replaced, but this can be minimized by avoiding hot spots. Another option would be to use a grade of plastic that is more resistant to sunlight. The two bottom layers of plastic tend to form tiny tears unless one is very careful in handling them, (that is why there are two layers on the bottom). A tiny hole may let a little water through and dampen the solid insulation, but this is not a big problem.

There are many variations of the solar puddle. We've been able to put the top layer of plastic into a tent-like arrangement that sheds rain. This would be good in a place that gets frequent brief showers. Adding a second insulating layer of air makes the device work even better, though this adds the cost of an extra layer of plastic.



As mentioned, the device can cover a larger or smaller area if more or less water is desired. One could make a water heater by roughly tripling the amount of water so that the maximum temperature was only 120° F or so, and this water would stay warm well into the evening hours. This water wouldn't be pasteurized though. One could help solve the problem of dirty water vessels by putting drinking cups into the solar puddle and pasteurizing them along with the water. The solar puddle could possibly cook foods like rice on an emergency basis, perhaps in a refugee camp.

Dale Andreatta can be contacted at **dandreatta@seaohio.com,** *or contact Derek Yegian at:* **dtyegian@lbl.gov** *or Dr. Dale Andreatta, S. E. A. Inc., 7349 Worthington-Galena Road, Columbus, OH 43085. Telephone (614) 888-4160, or FAX (614) 885-8014.*

FREE FRESNEL LENSES (big ones)

(pronounced fra'nel)

The fresnel lens in modern manufacturing is a piece of clear plastic sheet with very fine grooves in the surface. It has the effect of magnification, and thus the concentration of light. These lenses are widely used in the front screens of big screen TV sets, usually with two sheets in the front. One lens has fresnel grooves in it while the other may have vertical grooves. You want the one with the fresnel or circular grooves. In the photo below, you see one pictured next to a bike tire for size reference. It actually has a piece cut out of it on its bottom left, but it still works great. The photo to the upper right shows a piece of wood in flames instantly after the Michigan summer sunshine is focused on the wood with the lens pictured below. Many times, a distinctive 'POP" can be heard as the light is put on the wood in maximum focus. This is actually the hydrogen molecule that was part of the organic cellulose molecule (roughly $C_6H_{10}O_5$) being thermally disassociated and instantly ignited as the 3000F+ sunshine is put on the wood.

I get my lenses for FREE from TV repair shops. Look in the yellow pages and find ones that repair big screen TV's. Ask for "screens" that are scratched, marred, or damaged. These are normally thrown away. Good ones from broken TV's are saved for replacement parts for other TV's that are being fixed. The scratched ones are thrown in the dumpster. One shop saves three or four a month for me.

Sunshine is a very "diffuse" energy, meaning it is spread out. The concentration of the sunshine raises the "thermal quality" of the heat. Higher temperature means higher quality heat. The temperatures reached with a fresnel lens can be used to melt metal, especially aluminum and zinc. A well designed furnace with excellent insulation, good solar tracking, and focus will melt iron. It can be used to do biomass gasification, heat water, heat other gasses to make energy from the expansion of the gases (Sterling Engines). The fresnel lens works kind of opposite of parabolic dish. Both achieve the same result, but the fresnel focuses behind the lens and a parabolic system focuses in front of the dish. A fresnel lens is a tool not to be over looked in a person's experimentation and education in solar energy. The high temperature comes at a price. Precise tracking and focus must be done, but the resulting free high temperature heat is worth the effort.

These lenses are commonly sold through Edmond Scientific and other catalogs for between $75 and $150 each (brand new, not scratched). I prefer the scratched ones that I get for free.

CHEAP FRESNEL LENES (small ones)

One of my favorite sheet magnifiers is a seven by ten inch, very thin sheet magnifier that I got at Office Max or Office Depot. They cost about $8 each. Friends and visitors taking a tour of my labs always marvel at how fast a fire can be started with one of these small sheet magnifiers (fresnel lens). Most of the time, the fire starts instantly, especially on newspaper. It will make flames leap off of wood as well, just like the larger fresnel lenses described in this book.

Missionary friends of mine are interested in practicality of these sheet magnifiers. In many parts of the world, matches are so scarce or comparatively expensive that people will take ONE match from a small "book" of matches and rip it into six different pieces. One match is now six and can now start six different fires. (Try this yourself: separate the paper of the match in half, then rip the halves into three pieces each).

These sheet magnifiers can be found at most office supply stores such as Staples, Office Max and Office Depot. The magnifiers available in these stores are usually seven by ten inches, and are made of hard plastic. The lenses we supply are a very thin and flexible plastic that can be bent and rolled without damaging the lens. These will not break like the hard plastic ones in the office stores. In the year 2002, these became available at http://www.KnowledgePubications.com at a cost of $4.95 each. Quantity discounts are available.

I highly suggest obtaining some of these lenses and doing experiments. These are NOT like the little magnifying lens you played with as a child. Most newspaper will burst into flames (especially the dark areas of the paper). This will happen even in winter sunshine in Michigan. Make sure the lens is held PERPENDICULAR to the sunshine, and make a very fine focus. It takes about one minute of practice but it is really easy. BE

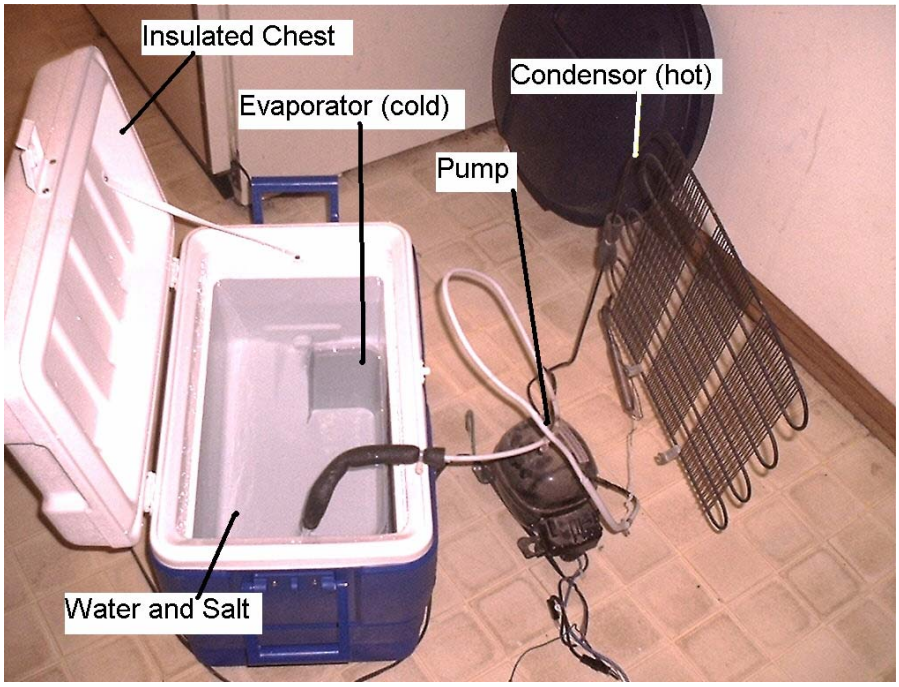
CAREFUL!! One customer was reading the writing on the clear wrapping around the lens while driving his car down the road. His car had a sun roof, and the sun was at the right angle. The lens was the right distance from his leg, and he set his pants on fire! This is a true story. With proper focusing, this lens will create temperatures in excess of 3000F.

A small fresnel lens starting newspaper on fire on February 2nd, 2002, in Michigan.

FREE INSULATION AND MORE

Metal surfaced, 1 3/4 inch foam core doors, FREE. Pictured here are a total of ten foam core doors I got for free. Seven are leaning up against my Dodge Dakota and three more are in the bed of the truck. I got all these for FREE, and more on the way. They did not come from a door manufacture, but from a company that buys the brand new doors by the truck load everyday, and then cuts knockouts (sections) from the door to inserts decorative glass, shiny brass handles and other accouterments. The doors I got are "slightly" marred or damaged, but do not affect its insulation value for me. I was hard pressed to even find the defects. I called door manufactures and installers, but the best type of business I found was the door "wholesaler." Again, they modify the base door and sell these to other wholesale and construction companies. These little panels are the "knock outs" from new doors. A large router cuts through the metal skin and foam, and then the glass is inserted. The knockout can be as big as seventy-five percent of the door if that door is going to have a large piece of glass in its center. Earlier photos of doors with mostly glass are USED, removed doors I got from the glass company I got the normal sliding glass door glass from. For free doors, knockouts and doors with glass in them, check with glass and mirror shops, door manufacturers, door wholesalers, and door sales companies. It takes some phone calls, but it did not take me long to start getting more doors, knockouts, and glass than I could handle. And, it was all for FREE. Smaller knockouts go in my attic for added insulation. A friend in Texas built an entire little café from nothing but door knockouts...floors, walls and roof. Go to Conger's Café in Hereford, Texas, for great food!

Mass Manufactured Refrigeration Components for Ice Making and Air Conditioning.



You cannot build a refrigeration system cheaper than you can buy a new one in the form of a refrigerator on sale in a big store. You can even get a refrigerator for free from places that reclaim the refrigerant before a refrigerator/freezer can be thrown away. They are usually HAPPY for you to take the refrigerator away instead of them having to remove the refrigerant oil and send the unit to the junk yard (and they still charge the guy who wanted to dispose of the refrigerator). I get my FREE refrigerators from my City Recycling center. People throw away working refrigerators all the time.

I had a small, working, under the table refrigerator, the type you get for less than $100, which I took apart. I stripped away the entire cabinet and refrigerator shell and took out the condenser, pump and evaporator. The evaporator is the part that gets cold inside the refrigerator, while the pump moves the refrigerant. The condenser is the part that gets hot on the back of the refrigerator (this is a heat pump, and it pumps heat from inside the refrigerator to the outside of the refrigerator). The cold evaporator gets to -5F in a well insulated container (which the original refrigerator is NOT).

I used a "5 Day Ice Cooler" for my initial experiments, but you can make an insulated container with wood and Styrofoam as shown in this book for making solar ovens and hot water heaters. Just line it with plastic to hold the water, and two inches of foam insulation around the unit. Insulation is the secret here.

Most people think of refrigerators as being power hungry, but these little units are very efficient and can be made even more efficient. This little unit draws ONLY ninety-three watts. It draws six hundred watts for about a half second on start up, but then settles down to ninety-three watts. I have run mine on a $28 four hundred-watt inverter (eight hundred-watt surge) with success.

The classic one hundred year old method of making ice (other than cutting it out of a lake) is to use mechanical refrigeration of some type (a refrigerator is mechanical refrigeration), and to cool water and salt (brine) as low a temperature as possible. In our example here, it gets cooled to minutes five degrees Fahrenheit. That's five BELOW zero (-5F).

To make the brine, just take tap water and salt and mix it up. The salt is available from warehouse stores (Costco/Sam's) and

restaurant supply stores (Gordon Food Service GFS) for about $3 for twenty-five pounds. Use a paint mixer on the end of a drill to mix the salt into the water. Stop adding salt when the water will not hold any more salt (you'll set it on the bottom and it won't dissolve). This is called a saturated salt solution.

When the brine is this cold, insert a container of fresh water to be frozen. Make sure the brine does not get in the bucket holding the fresh water. A plastic or a metal pail can be used. Most people don't know that really thin plastics conduct heat about as well as metal does. Plastic bags of fresh water, plastic pails, five gallon pails, and plastic "tubs" can all be used. These can have open tops or be sealed. A bucket of fresh water will "float" in salt water or brine. Brine has a higher density than the fresh water. This is the same reason that oil and other things float on top of water. Just don't let the brine get in the fresh water to be frozen if this is going to be used for ice cubes. Why use salt water? Why not just make ice cubes like one does in their home freezer? Air is an insulator, and it does NOT conduct heat very well. The object here is to freeze a bunch of water into ice with the lowest amount of energy. Someone trying to do this with solar panels does not have a surplus of energy. Cold refrigerant to metal (the evaporator), to brine, to plastic (the bucket), to fresh water, transfers heat MUCH better than metal to air, to plastic, and to water. If

you don't believe me, put your hand in a freezer and see how long you can keep it there. Next, put your hand in the -5F brine. You'll know the meaning of PAIN in the -5F brine. In the photo, Kim is holding ice that was made in a $1, three gallon plastic pail. Samantha is holding the pail, although you can only see the top of it. Three gallons of ice weighs about twenty-four pounds, and it took about two hours to freeze solid. Freezing bags of "flat" water works faster because ice is a less thermally conductive than water. It takes more time to freeze the ice in the center of the bucket. Flat and narrow is the best "shape" to freeze something in. Using a pump or agitator to move the brine around will also decrease the needed freezing time.

Other parts of this book will cover "chemical" cooling and ice making. However, the method above is the smallest and lightest way of making ice. It requires electricity or rotary horsepower of some kind to move the compressor, but this method can't be beat for its efficiency, size, and cost..."IF" you have the electricity.
Other parts of this book will talk about "microclimating" for the purposes of cooling a sleeping area or person. The cold brine or fresh water made by this method can be circulated by a small pump through a heat exchanger (such as an automotive heater core from the dash of a car), while air is blown through the heater core for the purpose of cooling a tent, room, or person.

Can you have ICE and Hot Water at the some time? Yes! This is easy, and you can make twice the amount of ice at the same time. Remember that we said that air is an insulator and a poor conductor of heat? While the evaporator is in the liquid brine, the condenser is in the air. The more efficient the heat is transferred, the more efficient the unit. Putting the condenser in a pool of water that can give up its heat to the atmosphere will increase the COP, or Coefficient Of Performance. COP is a measurement of how much "cold" a unit makes (or pumps) for X amount of energy. Increasing the heat transfer will not lower the pump load, but can DOUBLE the amount of ice that is made with the 93 watts of electric power my pump uses. You'll make the same amount of ice twice as fast AND have extra HOT water. Don't let the "hot" water get much above 110F, or you'll start lowering your COP. That is still nice bath water or a source of heat when it is cold.

Make Energy, Make Ice, Make Money.

The economics of energy are such that the last thing you would want to do is to sell the energy to the grid. The grid is the lowest price there is. The best thing is to use your own energy to make a product of higher value. Only when there is a surplus of energy would you "dump" it to the grid. Keep in mind that I am NOT talking photovoltaic panels in this example. There is no economics in PV panels except for the economics of you paying too much for a product.

I have an excellent example of the economics of energy. A good friend of mine in Haiti has taken it upon himself to feed many thousands of people a day. He sets up and runs churches and orphanages, and will help anyone. Haiti is a very poor country with little or no resources. There is nothing to manufacture, and nothing to export. It does have an abundance of sunshine, but we'll get to that in a bit.

The capital city of Haiti has electricity for MAYBE two hours a day, if that and it is usually on sometime around two AM. It is generally hot there and there is always a demand for ice. Not much ice is made in Haiti. I sat down with Stenyo and did the economics. By STARTING him with a surplus, very efficient diesel engine/electricity generation system, and by using cheap or free refrigeration components, we could help him make ice and make money to help feed people. The economics of it are such that $1.50 to $2.50 in diesel fuel would make thirty to thirty-five dollars of ice. Once we got him started and running using diesel fuel (which IS available on a "regular" basis), eventually we could move him over to solar ice making. Solar ultimately has better economics but is much more complicated, physically large with weights in the tons. The $300 diesel engine we got was a 3HP Lister (runs 20,000+ hours), a pair of deep cycle batteries as a load leveling filter ($200), a large diesel truck alternator optimized for max output at low RPM ($250), and a 1500-watt inverter ($225). The refrigeration components would be similar to those on the previous page. Of course, we would build our own containers from plywood, plastic, and foam to hold the brine, and cool the condenser with water to increase the ice making efficiency. To make an even higher dollar item, all you need to do is to take the ice, turn it into a snow cone, put flavor on it, and sell it at a fair. They aren't going to sell snow cones in Haiti, but this is an example of the economics of energy and how it relates to manufacturing.

The generator you see pictured is a " Dual Series Hybrid Diesel/ Gasoline Electric Generator." It is very similar in concept to a hybrid electric vehicle (which I am NOT a fan of). The inverter can generate 120V AC from either the batteries or the generator load leveled through the batteries. The batteries can be recharged by the generator and by the truck alternator and electrical system. The truck can also power the inverter. This unit has traveled with me for about 30,000 miles. It was on a 10,000-mile trip around the USA, and it ran my 600-watt air conditioner every night. It used about one gallon of diesel for every six hours of air conditioner operation. The air conditioner was keeping the trailer cool in a 100F+ ambient environment in the desert southwest of the United States.

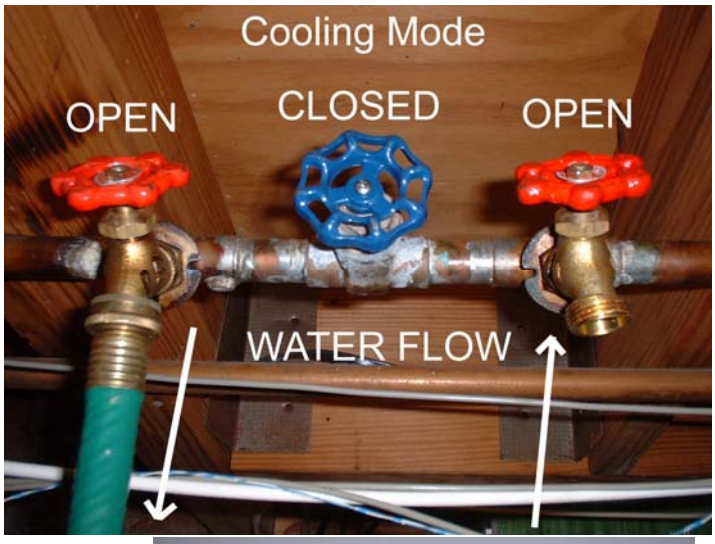
Diesel engines hold the world record for efficiency for a mass-produced chemical combustion to rotary horsepower device. Most of the newer diesel engines (DI Diesels) run at a higher brake thermal efficiency than most fuel cells. Want a vehicle MORE efficient than a fuel cell vehicle? Buy a new VW Turbo Diesel.

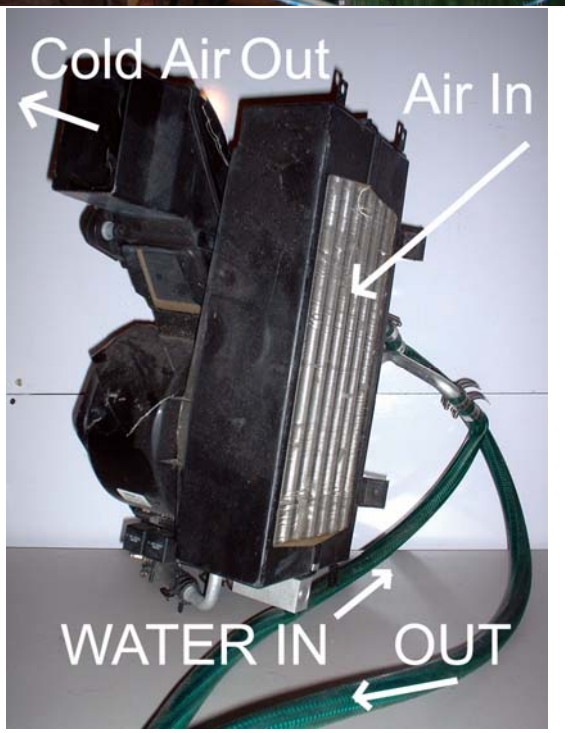
Water to Air
Heat Exchange
Hot Water for Heating
Cold Water for Cooling.

In the book, we talk about ways of making materials HOT and COLD. One of those materials is WATER, H2O. We are cooling, chilling, or freezing water and heating or boiling water. Many times, we want to use our hot or cold water for heating or cooling. Although solar energy is usually best used in heating a house by heating and moving air, many times heat for the night will be stored in water. Getting heat from the water into the house or sleeping area is also one of the best ways for storing "cold" for cooling during the day. Many times, we'll make "cold" at night and use it during the day the same we make "hot" during the day and use it at night.

I'm going to start this section with an example of using a heat exchanger for cooling the house.

How can you cool the house by watering your grass with warm water? It is easily done by putting heat into the water before it goes on the grass. I soldered two garden hose spickets (with valves) and a regular on/off valve into the 3/4 inch copper water line in my house. This is the line that comes from the main and feeds the rest of the house. The city or well water that comes into your house is generally near the Earth average temperature (eight to fifty feet down) of about 55F. This will vary by how deep your water line is, and how far it runs near the surface of the ground to your house. In Michigan, my water temp is 55F in the winter and about 62F (at most) in the summer. I really like blowing 63F air into my house on a hot 85, 90, or 95F degree day.





Normal Mode:
In normal operation, both of the hose valves are CLOSED and the center valve is OPEN. This allows water to flow through the house normally with no cooling.

Cooling Mode:
If you have well water, you can do this more economically all day long by moving water UP one well and then DOWN another well. If I tried to run my unit all day long for every room in the house, I'd have a water bill that would be a little expensive. However, there is no reason for me to put perfectly good cold water on the grass when it will take warm water just as easily.

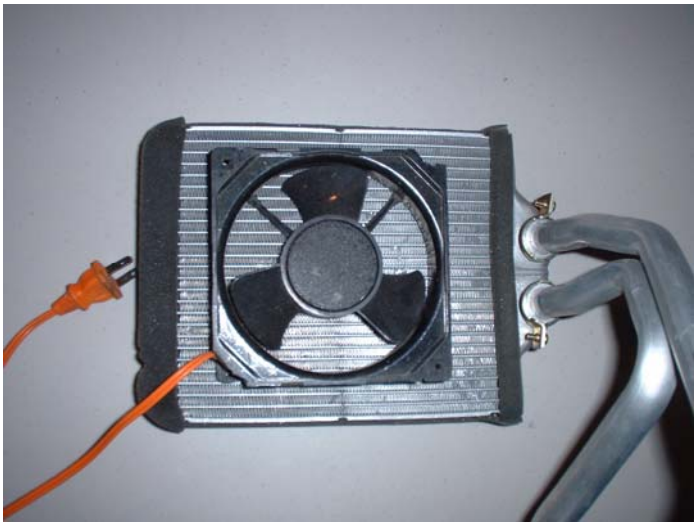
When I go to water my lawn in the summertime, I turn OFF the center valve (which actually would stop all of the water going to the house), and open up the valves that bypass the center valve, sending water through a hose. This goes through a heat exchanger blowing cold air into the room, while the "warmer" water goes back into the house water pipe through the second hose and valve.

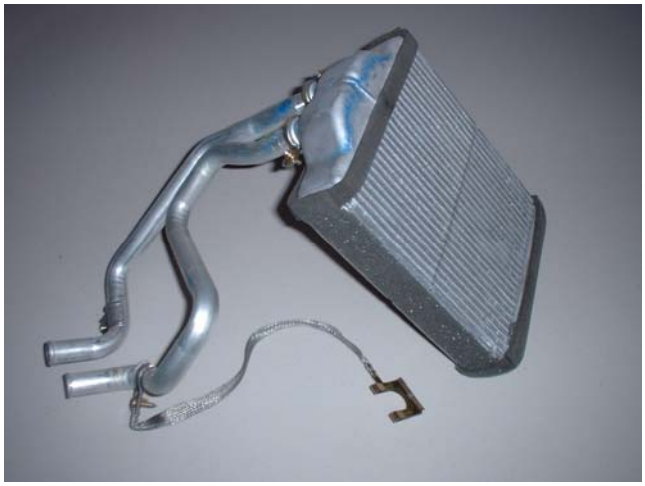
The heat exchanger you see is one from a large van. It is the auxiliary heater used to keep

people warm in the back of the vehicle. It is just a heat exchanger, and heat exchangers can heat and cool. In this case, we are moving cold water through it while moving warm air in one side and cooler air out the other side. You can find one of these at a junkyard pretty cheap. This one already has a nice blower built into it, and it really blows a lot of air. I use a 12-volt power supply to run the blower (or you can use solar panels and/or batteries). Sometimes, I have my free solar panels (covered elsewhere in this book) power the blower directly as the water flows through the unit. It blows cool air in my work area. If a cloud passes over, I can hear the blower go up and down (but I need less cooling anyway when it gets cloudy). Yes, I've used this for many hundreds of hours (summer of 2002) before I put it in this book.

How effective is this unit? How much cooling can it do? It dumps over 40,000 BTU's per hour of heat into the rear of a vehicle. In a cooling mode, we won't do that much. But, Trevor Babcock did a series of experiments on this for me, and it did over 3800 BTU's per hour of cooling. This was NOT optimized, but was just running quick and dirty. We had WAY too much water flow, over six gallons per minute. This unit really wants to run at a lower water flow rate (two gallons per minute), and a high airflow rate. If it runs at two gallons per minute, and there are 8.3 lbs of water in a gallon, and sixty minutes in an hour, and we raise the temperature of the water from 60F to 65F, then this will do: 8.3lbs/gal x 2gal/min = 16.6 lbs/min and 16.6lbs/min x 60min/hr = 996lbs/hr.

It takes one BTU to raise one pound of water one degree Fahrenheit, so if we raise 996 pounds of water five degrees Fahrenheit, then 996lbs/hr x 5 degrees F = 4980 BTU's/HR of cooling. This is the same as a 5000BTU, $120 window air conditioner, and you get this cooling for FREE. You were going to water the grass anyway, so why not cool the room when you flush the toilet with this system, or any water use will work.





Now imagine if you use eight gallons per minute instead of two gallons per minute. That's 20,000 BTU's of cooling, FREE. The air coming out of the unit will be near the warmest temperature of your water leaving the unit. In this example the unit would be flowing 65F air into the room.

If the larger heat exchanger I was showing is hard to find, you'll have an easier time finding this smaller one that goes in the dash of a car. This unit is about the size of a cigar box and is more suited for blowing cold air onto a person while sleeping using small fans and blowers. Don't underestimate this unit. By blowing 250CFM (cubic feet per minute) of air through it, you can cool an entire room very quickly. I cooled my 12 x 12 foot bedroom from 85F to 72F in about forty-five minutes with this very heater core, but I had a bigger blower. This does not have to operate with a large, power hungry blower. We'll be showing how to do microclimating work in the book. For this,

you can use a much lower water flow rate through the unit (one tenth to one half gallon per minute), and a small blower at 10, 20, or 30CFM. This is actually a "muffin" fan from a computer power supply. It runs on 120V AC, and you can use a light dimmer to control its speed. To make the little blower more effective,

Make a duct (box) between the fan and the heater core with cardboard, hard plastic or plastic sheeting or wood to force all of the air through all of the heater core.

separate the two units using cardboard, plastic, and duct tape or liquid nails to form a shroud between the blower and the heater core. This moves air through the entire heater core. Muffin fans vary greatly in their output. The ones that are quieter are down around 10-30CFM, while the noisier ones are around 100CFM. Of course, this rating is in the open with little restriction. The heater core provides a restriction, depending on which one you have, what the tube and fins spacing is used, etc. I'd rather have a 100CFM muffin fan and put a 120-volt light dimmer control on it to adjust the speed than to have one that is too small. It does not matter how much cold water there is flowing through the heater core if you don't have enough airflow. It will not cool your room or space. In technical terms, it is stated as the Q of the air being equal to the Q of the water. This means that the cooling absorbed into the air must equal the heat that went into the water. If you want to understand how everything works around you, people, trees, cars, the sun, etc., then study thermodynamics and heat transfer. Your life will never be boring.

GETTING ABSURB (but interesting) WITH USING THE WATER.

I did a crazy experiment with the cooling water on the previous page. I took the cold water from the water line (to water the lawn) and used the water to cool the house. Then I ran the water to a hose sprinkler on the roof of my house. The water cooled the black shingles on top of the hose (thus removing solar heat input to my house that needed to be cooled). The warmer water ran into the gutters on the roof, and I directed the water down to the condenser of an air conditioner I had running in my main den. The water on the condenser of the air conditioner improved the heat removal from the condenser and thus raised the COP (coefficient of performance) of my air conditioner. I was making more cold for the same amount of electricity. I then ran the much warmer water from the bottom of the air conditioner through some pipes and conduits to the grass, and now the grass was watered. This was an experiment, and it worked, but it was a little too...well...I didn't need the neighbors laughing that hard at me. It would have taken considerable effort to make this a permanent part of the house.

ENERGY CASCADE

The French solar energy pioneer, Trombe, considered the use of solar energy to heat water to make steam to turn a turbine, which in turn made electricity. This was a waste when the same energy could melt steel. This is true. You can take 4000F+ solar energy and melt iron (2300F), use the iron to melt brass (1800F), use the brass to melt aluminum (1200F), use the aluminum to melt zinc (900F), use the zinc to melt lead (600F), and use the lead to heat the water to make steam to turn the turbine to make electricity.

Now there is a thought that will keep you up at night thinking.

Steam Distillation; Salt Water to Fresh Water "Desalination"

This unit is a variation of the solar hot water heater already documented in this book. This unit has the ability to vaporize the water in salt water and to condense those fresh water vapors to move the vapors and/or the fresh water out of the unit.

This is important not only for turning salt water into drinking water (distilled water), but the unit can also do water pasteurization (see the solar puddle article). Further, the solar distillation unit will be a very important part of our system to make ice by chemical methods as well as for the harvesting of moisture (water) from the air.

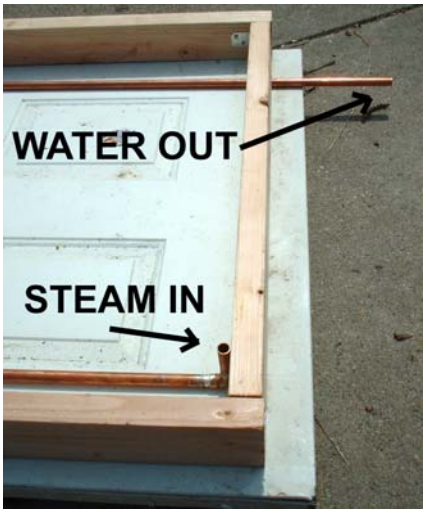
Like the other solar hot water heaters in this book, this is a double-layered glass (sliding glass door glass) over 2x4's and plastic (for holding the water) sitting on a door (for insulation). Copper was added for condensing the steam.

I used a half inch copper pipe, but three-quarter inch could have been used. Plastic or PVC pipe could have also been used. I used copper because it conducts heat better than PVC pipe, but PVC is cheaper and easier to work with.

First, make sure the unit is level. Then add water to the unit, making sure you don't get water in the STEAM PIPE. It can easily hold fifteen gallons of water.

The steam in pipe is about one-quarter of an inch below the 2x4-inch edge and the glass. Water vapor/steam will form from the water being solar heated between the top of the water and the glass. The water does NOT have to be at 212F (boiling) for this to happen. As the water gets hotter, a slight pressure will build up. The water vapor will then exit through the STEAM IN tube. When it flows down the tube, it will lose its' heat through the copper tube and black plastic and give it up to the water. When the water loses enough heat (975 BTU's per pound), it will go from a vapor state back to a liquid state. This is called a "Double Acting" distillation unit because the heat used to vaporize the water gets put back into the water being heated. The water will condense in the copper tube and flow out as water. IF enough solar heat is added, like with a reflector, or if it is hot enough outside, all of the

The Completed Unit



Close up of the Steam In and Water Out

Copper pipes and wood under the black plastic and glass

Close up of the Steam In pipe, use silicone caulk to seal this to the plastic.

water may NOT condense in the pipe, and steam may escape. If this occurs, then a second condenser will needed (see the previous articles on water desalination/ distillation).

I used about twenty feet of half-inch copper pipe in the heat exchanger. Each ten-foot "stick" cost about $4 at Home Depot. It was cut with a tubing cutter and soldered together with a propane torch (a tutorial on soldering tubing is beyond this book, but it is easy enough to ask the guys at your hardware store). Depending on your location, you can use MORE or LESS copper pipe. Plastic piping is also an option. If you have water vapor escaping on a regular basis, then you'll want more pipe. This unit easily got up to 190F on a clear, April day in Michigan (with no reflectors, just the glass laying flat). When the water temp gets this hot, it will be very hard for the 190F steam vapor to transfer enough heat to surrounding water to fully condense, an additional condenser will be needed.

METAL CORNERS
To fasten the wood together on this unit, I used metal corners from Home Depot. The corners cost about fifty cents each and took a total of two screws. I found this easier than screwing the wood together, but that is still an option. Even nailing the wood together is an acceptable option. The principle is NOT to follow this book STEP BY STEP, but the principle is to USE WHAT YOU HAVE.

...and the water is deep, too...
I used 2x4-inch wood for the sides, but if you wanted to hold MORE water then six inches, eight, ten, or twelve-inch wood could be used. You'll have to make the corners more secure and you might want to screw it to the bottom board/insulation, but this is a viable option. It will take longer to heat up, but you might not need to add water in the middle of the day.

DON'T RUN OUT OF WATER
Do NOT run this unit out of water. The plastic sheet will MELT and get holes when the unit runs out of water. For a long life unit that does not require attention, you might want to consider making the inside material sheet metal that is sealed with silicone or something else. For doing experiments and homework, the black plastic sheeting is great way to start. If you melt some plastic, don't worry about it. Learn from the experiment and make it better with what you have available.

YOUR ADDITIONS TO THIS
To make this more of an automatic system, a person should add a float switch (like from a toilet) to automatically fill the unit with water when it gets low. This would require adding a copper tube to add water to the unit. Depending on the double layer glass you are using, you may or may NOT have to seal the glass to the plastic and wood. For our work, I did not need to do this. For a permanent instillation, I would seal the glass and plastic to the wood. Silicone caulk will work fine.

***** IMPORTANT *****
PRINCIPLES IN THIS UNIT for MAKING ICE and COLD
Keep in mind the PRINCIPLES of how this unit works. Sunshine on glass over water with insulation drives the water away in the form of steam and leaves everything else behind. It will leave bugs, rocks, salt, minerals and everything else in the unit. Put in seawater and let it run and you will have only salt left in the bottom. We will be using this PRINCIPLE to recycle and reuse our chemicals (salts) for making solar ice and solar refrigeration and other fun solar chemistry.

Sunshine To Dollars DVD
Much of the construction of this unit is documented on the Sunshine to Dollars DVD available at www.KnowledgePublications.com.

HOUSE CONSTRUCTION
Brain-dead Simple vs.
Brain-dead Stupid.

I'm going to talk about new construction and solar energy, and under NO TIME during this am I talking about solar photovoltaic energy. Real solar energy is solar thermal energy.

Construction companies, their customers, and the whole industry are passing up economic opportunities everyday, and flushing dollars down the toilet. By not integrating year 2003+ mass manufacturing of plastics, glass, and metal into modern construction, they are like a teenager turning down an eight-year scholarship to a university.

Why is this not being done? Because "YOU ARE NOT DOING IT." You, the reader, sitting there on the couch and reading this book, are the reason nothing is being accomplished. YOU are not doing it. Forget saying "they's" and "them's" (such as, " Why aren't 'THEY' doing it?"). There is absolutely NO reason anyone with the desire cannot implement many of these items into a future house construction.

It is at the time of construction that many of these best practices should be implemented. I'm not talking real expense here, and some of the return on investment can take less than a year. Some of the methods SAVE you money on construction. It can actually be cheaper to put tempered glass on a roof than it is to use plywood, tar paper and shingles.

LOOK AT THAT SURFACE AREA!

Look at the roof of the business pictured. The entire area above the wall line is all "unused attic." The southern exposure of this building is enough to heat and cool it all summer and winter. There is enough surface area there for it to heat and cool adjacent buildings. Those little additions to the roof with windows are only for appearance, money spent on image with no function. Look at the photograph of the windows in the house above. There is probably $5000 in window work, and yet $5000 could completely make this $350,000 house solar heated with a return on the money spent over a few Michigan winters (a typical house like this can have $200 per month heat bill, or a six month average of $1200 per year...making a four year return on investment). I did not even factor summertime solar cooling into this number.

Most new houses have enough North/South surface area to integrate a reasonable amount of solar for heating and cooling. All of the mass manufacturing and methods exist today to seamlessly integrate this with modern heating and air conditioning systems. I am not suggesting the replacement of current forced air furnaces and central air conditioning systems, but the augmentation of them with the economics of sunshine falling on the house all year round.

Sizing a solar heating/cooling system to make a house 100% independent becomes VERY costly. Supplementing the house with available sunshine becomes very economical. It is the minds and thoughts of people that have been polluted that has caused solar augmentation to be bypassed. All solar heating and cooling in an on-demand world with a hundred years of grid infrastructure does not make economic sense.

PUT SOLAR IN WHEN YOU BUILD.

This roof truss system on the right is just begging for some glass and heat passages to be integrated. A "Modern" building methods has these sections being quickly fabricated on the ground at the site, and then hoisted with a crane onto the house. At this time glass, additional wood and insulation with a few heating ducts can be as easily integrated as roofing plywood and tarpapers are put on a standard roof.

Construction companies dig holes and fill them with concrete to make a basement with lightning speed and efficiency. Don't ignore the discussion of storing solar heating and cooling in the attic, walls, and roof area of a house (which we recommend), when the traditional method of solar heat storage is a hole in the ground with rocks or bottles of water. All of the mechanisms are there to make thermal storage exist today in our modern basement building methods.

IT IS STILL 1930!!

We building houses and turning down our free "Solar Economics Scholarships." It is the 21st century, and we are still building houses almost exactly the same way we did in the 1930's, with concrete, 2x4's, insulation, plaster, plywood and shingles. The biggest difference is that we now have power nail guns and other power tools instead of hand tools.

We still make a 2x4 frame, and put drywall on the inside and brick on the outside. Anyone making a thermally efficient house knows that you put the thermal mass (the bricks) on the INSIDE of the house, NOT the outside. We have world-class materials that look like bricks and give brick-like protection from the weather, but we still spend twenty man-days laying one brick at a time with mortar around a house. What a waste of money and human effort.

Really good 21st Century construction involves the use of Structurally Insulated Panels (SIPS) and Insulated Concrete Forms (ICF blocks). If you are going to build a house, at least look at this 1960's technology. Foam walls and shotcrete, and inflation forms with shotcrete are another great form of construction. We have ignored modern methods used in other businesses and ignored modern composite materials and METHODS just because this is the way we've been building houses since 1930. Most builders have their heads up their rears so they can stare at their pocketbooks from the inside out. Not Invented Here (NIH) syndrome and complacency are two additional reasons these methods are not widely used. YOU not doing it is another reason. Foam, plastics, wood composites, and filler reinforced concretes with new materials are all fields that are WIDE open, waiting for someone with vision and commitment. Fortunes on the scale of billions await those who undertake the mission. Your biggest obstacle are the people who could not find their rear end with both hands and who have fingers perpetually stuck up their noses.

Future versions of Sunshine to Dollars and the Sunshine to Dollars DVD will cover this subject in much more detail.

UPDATES TO THIS BOOK and ENERGY PHILOSOPHY.

This book was born on January 3rd, 2002, when I sold the first sixteen-page version on eBay. Since then, I have continually updated the book and kept on putting out a new version about every two months. This version is the seventh version of the book, and is the first one to have the solar cooling systems in it.

Through my professional life, I have always photo-documented the experiments and work that I did. This book was born from the photos and documentation of many of the projects I have done. I did not do experiments initially for the purpose of the book. It was actually the other way around.

As I now continue my solar experiments and work, I continue to take photos and to expand the book. The book gets expanded and taken into new area as one experiments leads to another. You will see several generations of solar heaters, distillation units, and ovens in the book, as one has grown into another and another etc. Each section of the book could actually be expanded into a whole book itself.

The solar experiments in this book are NOT what I do professionally. I do professional development work on solar energy systems that can supply the USA with all of the energy it needs for automotive transportation, heating, cooling, and electricity. The experiments I do for this book are for my fun, and are my hobby. However, keep in mind that these experiments are illustrating principles behind solar energy, thermodynamics, and material science as well as energy and heat transfer. It also deals with modern manufacturing and other modern science methods. Real solar energy and solar thermal energy that can provide enough energy for everyone on the planet, whether there is six billion, ten billion, twenty billion, fifty billion, or more, all has its basis in this book. The experiments in this book are simpler and at lower temperatures than many of the "cutting-edge technology" methods we are doing development work on right now, but the PRINCIPLES are the SAME.

The energy field is exciting. It is growing, and is the single largest market in the world. It is responsible for the quality and quantity of human life and our technology advancement more than anything else. To limit energy is to kill human beings.

When I talk to people about the solar energy businesses and solar heating for homes and solar cooling, they say, "Yeah...look at all of the energy people can save."

WRONG It is NOT about saving energy. The methods I show and teach for you and your house, and for the future of man, are NOT for saving energy. It is for USING MORE ENERGY. We, as humans, will ALWAYS use MORE AND MORE energy every second of every minute of hour of every day, year, decade, and century. It cannot be stopped, and it is NOT bad. It is what keeps us alive and keeps us advancing. As man advances, he always improves himself. The two things that historically enable him are communications and energy. To stay at the same level of energy use for even one day is the same as reducing energy, and thus the people on the bottom of the energy ladder fall off and die.

So keep on experimenting and keep on thinking. As my dear friend and fellow instructor, Al Kargilils, says, "You must be a warrior poet."

More and newer versions of this book will be coming out every couple of months. In the winter, I add items about solar heating. In the summer, I add things about solar cooling. During the year, I add things about solar cooking, the uses of solar energy, and the needs for solar energy.

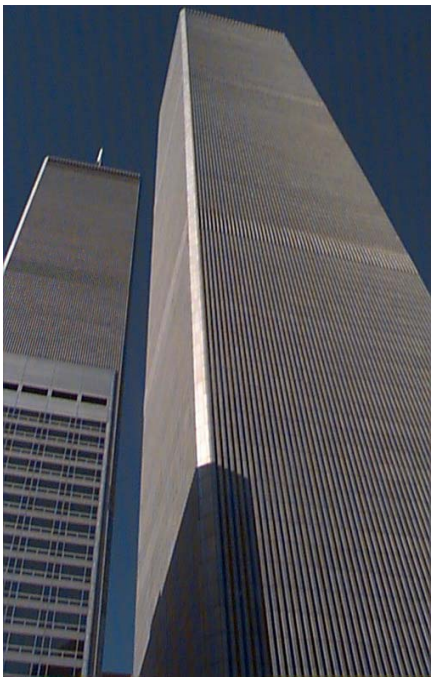
Hey…it's falling on your head all day, and it's free, so you might as well use it.

Also note, I am now documenting my experiments with video and there will be a *Sunshine to Dollars DVD* coming out soon with exciting and FUN video.

All my Best,
Steven E. Harris
http://www.StevenHarris.net

Civil Defense & Solar Ovens

Normally in a Solar Energy book, this is where someone will say something about foreign oil, US politics, and energy independence. This book won't address this in the aspects of solar energy and civil defense because it just does not matter.



Natural disasters and man-made disasters will befall us in the future. It can't be stopped. Hurricanes like Andrew will make entire areas helpless for days and weeks, and people who hate the USA will do something far worse than Sept 11th that will kill millions of Americans. It won't be billions of dollars of damage, but trillions of dollars of damage to the economy.

I have been volunteering my time and working in the Emergency Services and Civil Defense field for almost twenty years now. I've contributed papers and ideas to the Center for Disease Control, Public Health Service, FEMA, the US Air Force, US Special Forces, and other public and private institutions. I also teach simple home and family preparedness in seminars and classes and one on one.

I wrote earlier in the book that safe water, sewage removal, antibiotics, and abundant energy were the key reasons why we have six billion people on the Earth in 2002. In disasters of epic scale, a population quickly loses water and energy, and people start to die in days.

A complete class on preparedness is well beyond the scope of this book. However, I do want to point out that a solar oven and some white flour, water, salt, and baking powder makes very nice biscuits.

Water obtained from a river or lake is "safe" to drink after it has been heated above 160F in a solar oven.

For a group of people who have the mission to help others in a time of need, a large solar oven like the one in this book can bake one hundred loaves of bread in a day without using up very precious fuel.

Consulting in the Energy Field:

The author of this book, Steven E. Harris, is available for professional consulting to individuals and corporations. My specialty is creative development work. This is particularly useful for investors and start up companies wanting to break into emerging opportunities in the energy field. I have done a lot of work helping companies come up with a viable concept and method of approach for the market they want to target. I provide the ideas and the spark for the talent pool in the group to ignite and "combust" forward with products and ideas.

I bring unique qualities of creativeness and a depth of experience to a group. My best role is in the augment of existing infrastructure, for it is ONLY with infrastructure that anything can really be accomplished. I'm not there to replace any personnel, only to augment the existing system.

Although I understand the majority of the energy field very well, many companies have particular interesting in my knowledge regarding:

Solar Thermal Energy
Solar Thermal to Kinetic Energy
Solar Heating / Cooling
Hydrogen in General
Reformation to Hydrogen from Biomass or Hydrocarbons
Steam Reformation
Partial Oxidation
Pyrolysis
Energy Philosophy
Internal Combustion Fueling by Hydrogen or other fuels
Automotive Test and Development
Aerodynamics and Thermal Management of Vehicles.

My extensive consulting portfolio is at: http://www.StevenHarris.net

I understand energy, its relationship to human life, and the advancement of society. I understand the history and development of energy, where it is today, where it WILL BE tomorrow and what the future of energy is. From wood to charcoal, from coal to coke to heavy hydrocarbons to light hydrocarbons to organic solids and liquids to IC engines, from turbines to fuel cells and the future regarding solar, hydrogen, fission, fusion and anti-hydrogen; myself and those I work with; we understand.

Questions regarding my service can be sent to h2fuel@mail.com.

Consulting for the Homeland Security & Civil Defense Field.

I have contributed my time and expertise to the Emergency Services field in one respect or another for the last 20+ years. I have a extreme commitment to the protection of human life and particularly to civil defense in the USA.

I have worked with private individuals, public and private organizations and different areas of the US Government, and have been mentored and taught by some of the finest talent this country had in the field of civil defense.

I can consult in the protection of human life from nuclear, chemical and biological threats. The largest threat to all is the loss of infrastructure from any of the these threats.

I am in expert in the equipping and supply of emergency supplies, methods and procedures. This expertise spans everything from food and water to energy and illumination, health issues and communications, and especially the question, "What do we do?"

This can be for a individual crossing the pacific in a sail boat to a large corporate need. I have configured food and resources from fifty people for six months all the way down to a individual families needs for a week.

24/7 Institutions and Emergency Operations Centers (EOC)s will find my talents of particular interest.

If you, your family, extended family, a corporation, or organization wants to be prepared for whatever threat is a primary concern to you, contact me and we'll make sure you're ready and we'll take you VERY seriously.

My approach is simple, basic, based on principles. My education is hands on, direct and non-forgetful. The items I use are mostly off the shelf and I guarantee you won't be spending huge amounts of money on funky freeze dried fruits, nor will you be choking down grainy wheat bread. A FREE Family Preparedness Class is at http://www.KnowledgePublications.com

My Homeland Security / Civil Defense Consulting Portfolio: http://www.StevenHarris.net h2fuel@mail.com