WELCOME TO OUR SOLAR HOUSE

4512 38th Avenue South, Seattle 98118

Enough energy from the sun strikes the lot on which our house sits, to provide the electrical needs of our house, plus all the houses on both sides of this block. We can't harness all of that energy, but we can harness enough of it to make a substantial reduction in our use of City Light hydro generated electricity.

We are concerned about our "ecological footprint", i.e., the cost in resources each person uses to support his or her lifestyle. This includes the land used to grow the food we eat; the water (and fuels) used to generate the electricity we use; the energy used to produce the products we buy, and so on. If you multiply the average ecological footprint by the number of people in America, you quickly conclude that we are rapidly exhausting the available supplies of those resources at an unsustainable rate. In short, we are leaving a resource-deficient world to our children. That is a sacrilege. We concluded that we could seriously reduce our ecological footprint while maintaining a high quality of life, by making resource conscious decisions. We began thinking about solar power.

YOU KNOW, KERMIT, IT'S NOT THAT HARD BEING GREEN

Before installing these solar systems in our home, we eliminated as much wasteful energy as we could, beginning with simple things like replacing incandescent bulbs with flourescent bulbs or LEDs. I borrowed a little gadget from work that you plug into a wall outlet, then plug any appliance into it. It will give you a readout of how much energy that particular appliance uses. Using information from that, we decided to replace the biggest energy user, our refrigerator, even though it was only about ten years old. The new refrigerator uses a quarter of the power.

There is a rating system called "Energy Star"; appliances are rated by their efficiency and their estimated annual consumption in kilowatts, and their place on a spectrum of similar appliances, is listed on a yellow tag. In many cases, you can get rebates from your electrical utility for purchasing especially efficient appliances. They may cost more, but the cost is offset by lower electrical (or natural gas) bills, and you will be helping the environment.

We replaced our 1990 top loader washer and dryer with a new front loader washer and stackable dryer. The new washer uses 75% less water, and does a better job. That much reduction in water is also a reduction in the amount of energy used to heat the water. The dryer is more efficient, too. There is a big market for used appliances among apartment building owners; we unloaded ours at a reasonable price just a few hours before our new appliances were delivered. It's important to properly dispose of old appliances so you don't end up creating one problem by trying to solve another.

SOLAR WATER HEATING

Once we had the house "energy organized", we began installing solar, starting with the solar water heating system. Jeremy Smithson of Puget Sound Solar had parts on hand and the work could be done right away. To create room in the utility room for a second water tank, we made sure to get a stackable washer-dryer combination. We removed one of the wall cabinets. Jeremy needed to reposition the remaining one and he did a great job of fitting it all in our tiny utility room.

Here's how the water heater works:

The solar water tank is inserted between what I call the "city water tank" and the inlet from the city water main. We use solar energy to pre-heat the water that goes into the city water tank, which shortens (or temporarily eliminates) the operating time on the electric water heating unit. On cloudy days, or at night, the water in the solar tank is still at least twenty degrees warmer than the water coming in from the city main. This means that the electric water heater, running on City Light power, has less work to do to bring the water at the tap up to the normal 120 degrees. When the sun is out, the water in the solar tank heats up rapidly and the electric element in the city water tank never goes on.

The system is relatively simple and has five main components: the rooftop collector box, the water tank, the pump, the temperature regulator, and the propylene glycol heat exchange medium. Propylene glycol is similar to automotive radiator coolant, but is biodegradable and non-toxic. Our system uses about one and half gallons of propylene glycol which needs to be replaced every three years or so.

The propylene glycol is pumped to the rooftop collector box through insulated copper pipes. In the collector box, the copper pipes form a serpentine network enclosed by high impact resistant glass vacuum tubes which trap infra-red radiation (and heat) in the same way your car windows allow your car to get very hot in the sun. Because the glass tubes are in vacuum, there is little conductive heat loss and the collector box is efficient even in very cold outside temperatures. The heated propylene glycol is then pumped down from the rooftop collector box into the solar water tank. Inside the tank, the copper tubing forms a coil (to maximize surface exposure), where it heats the water to a pre-set temperature, before being pumped back up to the rooftop collector box to get reheated. The temperature of the water in the solar tank is determined by how slowly the heated propylene glycol moves through the system; the slower it moves, the more heat it imparts to the water in the solar tank.

The temperature regulator allows us to set a maximum temperature, above which a safety valve opens and the solar water tank discharges into the city drain to reduce the pressure. The temperature regulator also allows us to set a differential temperature between the rooftop collector box and the water in the solar water tank. This is usually set to about five degrees. When the temperature on rooftop exceeds five degrees above the water in the solar tank, the regulator turns on the pump and to begin pumping the (now) warmer propylene glycol from the roof into the solar water tank. A temperature difference of five degrees or less makes it energy inefficient to operate the pump.

THE SOLAR PHOTOVOLTAIC SYSTEM

The solar photovoltaic system, installed by Jim Bristow and Larry Owens, is also quite simple, although there is an extremely high demand for the solar panels themselves which will necessitate some planning ahead. Depending on the desired power output, virtually any number of panels can be mounted on the average rooftop; the limits are the size of the roof and your budget. It's more cost effective to order a complete system (the largest you can afford) and install it all at once, rather than doing it over time. Each panel is about 3ft by 6ft and 2 inches thick. They are either mounted on fixed brackets, as we have, or rotating brackets that can track the movement of the sun and keep the panels oriented. A fixed bracket is much simpler, cheaper, requires no maintenance, and is adequate when there is a good southern exposure.

The panels are like giant batteries and are connected in series, just a like row of D-cell batteries in a science project. The panels each put out about 175 watts. We have twelve panels on our roof, for a total output of approximately 2100 watts. This power is DC current, which is not compatible with City Light or household appliances. The current is fed into a DC

disconnect switch, then into the SunnyBoy inverter, which converts the DC to AC. From the inverter, the current is routed to another disconnect switch, which allows the solar photovoltaic system to be isolated from the City Light grid. There is a meter attached which looks just like the City Light meter, to record the output in kilowatt hours of the solar panels.

By Federal law, electrical utilities are required to provide some sort of reimbursement to folks who supply power from renewable resources such as wind or solar. City Light employs the best type of reimbursement, called "net metering". Once your system is installed and inspected, you complete a simple contract form with your electrical utility which, in effect, recognizes you as both a user and producer of electrical power. The contract provides for the electrical utility to pay you for the power you generate by permitting your solar photovoltaic array to run the utility's meter backwards. In effect, the utility is paying you the retail rate for the surplus electricity you generate.

We also get paid a modest ten cents per kilowatt hour by the Bonneville Foundation (not Bonneville Power). We submitted a request to have our system listed among the sources of green energy that utilities use to offset their production of electricity by more polluting or resource depleting methods. When utilities offer customers a chance to buy green energy, they are buying it, in part, from us.

Here's how the photovoltaic system works:

The solar system puts out approximately 1800 watts AC (the inverter uses up some of the DC power during the conversion from DC to AC). If our house is using less than 1800 watts, which is the case when we are not at home, the surplus is routed back into the City Light grid and our City Light meter runs backwards discounting our total bill at the same hourly rate that City Light charges us when the meter runs forward. The savings are greater when the solar array is operating during higher use periods where the utility rate per kilowatt hour is higher.

The Sunnyboy inverter has a "handshake" protocol that it initiates with the City Light grid to protect City Light workers from inadvertently being electrocuted or shocked by power coming out of our system should they be working on the power lines. When the solar system is first turned on, the Sunnyboy first checks to see that the City Light grid is up and running. If it is, it then initializes the solar system and puts it on line. The inverter maintains this handshake for the entire time the solar system in on line. If there is a power outage, or if City Light turns off the power to the grid, our solar system also goes off line.

Some folks opt to use batteries and remove themselves entirely from the city grid. This is quite feasible, although the batteries require maintenance, are expensive, and take up room. We are using the City Light grid as our battery. During the day, the solar system pumps power back into the City Light grid and runs the City Light meter backwards. In the evening, we come home and use electricity, but now, the City Light meter is starting from a lower setting than it had in the morning before we left the house.

THE GOVERNMENT FLUNKS ENVIRONMENT 101

Both the Bush Administration and the Clinton Administration failed to address the double issues of global warming and our dependence on fossil fuels and other environmentally damaging energy sources. This failure of leadership does not bode well for the world we are leaving to our children.

In the absence of leadership at the federal level, it becomes our responsibility to do what we can, within our means, to reduce our individual environmental footprint. To that end, we've made a major investment in our solar system, spending funds that we might have used for other purposes.

Installing a full blown solar system is a commitment that not everyone is able to make for a variety of reasons. Apart from the economics, many people live in homes not properly

situated for solar power, or they live in apartments where they have no control over their rooftops. There are “green power” programs available through City Light and other utilities, that allow you to purchase “green credits” which are used to offset the costs of providing environmentally friendly, renewable energy. The surplus power produced in our system is paid for, in part, by green credits purchased by socially conscious power consumers.

There are myriad ways to reduce our ecological footprint. The most obvious is simply to consume less. If we continue at our present rate of consumption, we will need two and a half planet earths to sustain the demand on resources. If we reduce our consumption by about 10 percent, annually, we will only need our single planet to sustain us.

Stewardship of the planet is more than focusing on saving money. Environmental practices will, however, save money because the increasing scarcity of resources and the true cost of environmental damage, will make inefficient and polluting enterprises uneconomical and unsustainable.

Gradually, people all over the country are becoming more concerned about our deteriorating environment. Some are getting angry at the government for doing so little and for being in bed with those who would sell our natural heritage to the highest bidders for short term gain. The excitement and positive energy we felt about our solar project is being repeated all over the country, and the world. Denmark was a net importer of foreign oil in 1990 until they decided to become energy self sufficient and renewable. Now, energy is a major Danish export.

You are welcome to visit our house. Don’t hesitate to call us (206) 725-0480 if you have questions about solar power, hybrid cars, and biodiesel.

Bob, Lyle and Matiah
captainbaba@hotmail.com

Resources:

Larry Owens: (206) 654-4596 (cell). (lowens2@earthlink.net)

Larry is the president of the Shoreline Solar Project (www.shorelinesolar.com) and vice-president of Solar Washington. Solar Washington (www.solarwashington.com) is part of a national organization. Larry is highly competent to work with you on any issues regarding the installation of solar energy systems.

Jim Bristow: (206)841-1964 (jameseb63@yahoo.com)

Jim is a residential building contractor who has moved more into the installation of solar photovoltaic systems. He is the owner of Bristow Enterprises, which does residential construction and remodeling, and, together with Larry Owens, is a partner in: B & O SOLAR. B & O SOLAR is committed to high quality installation of solar photovoltaic systems. They did the photovoltaic installation at our home.

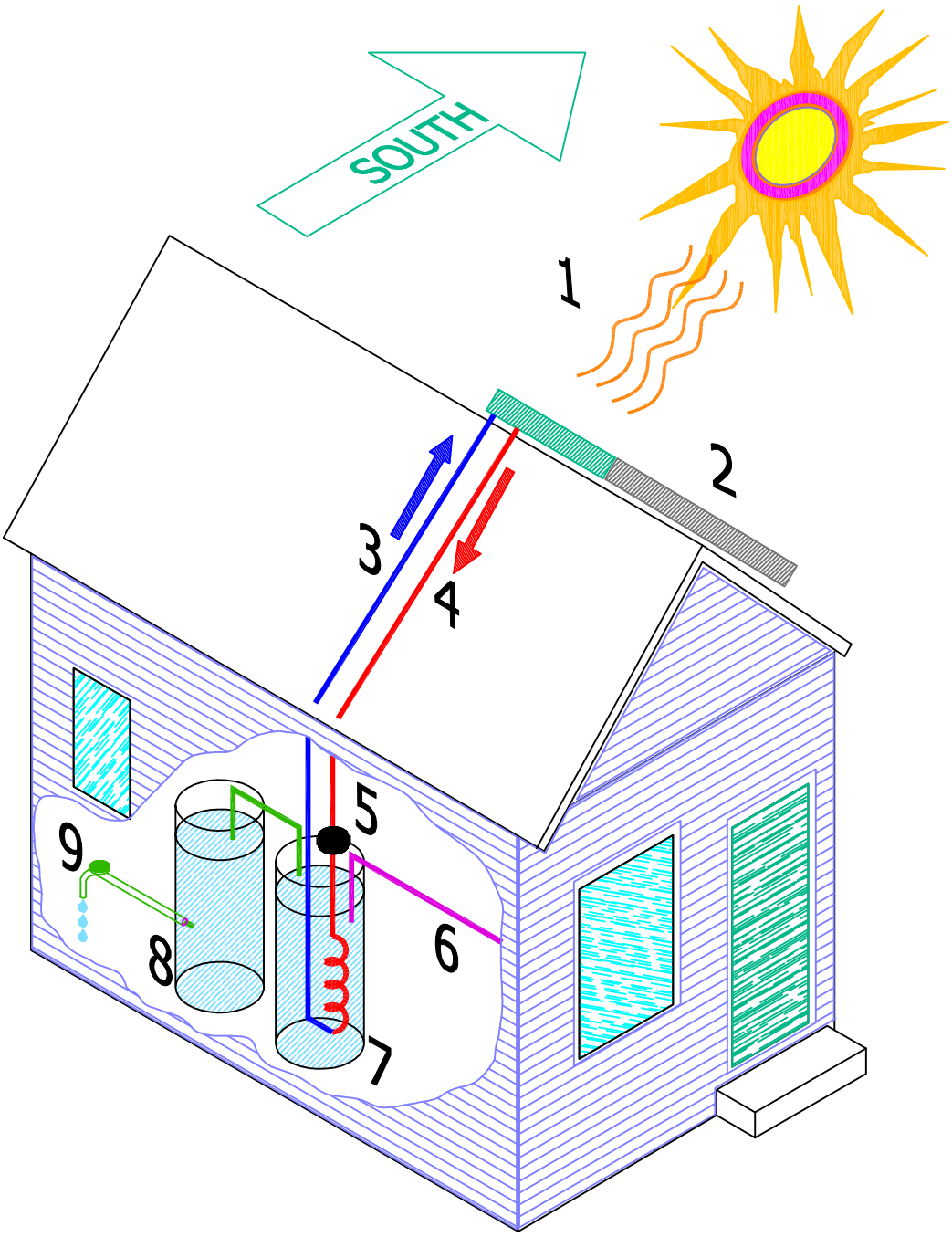
Both Larry and Jim have been certified by Solar Energies International (SEI), an agency that trains people to do solar system installations.

Jeremy Smithson and Pamela Burton: (206)706-1931 (www.pugetsoundsolar.com)

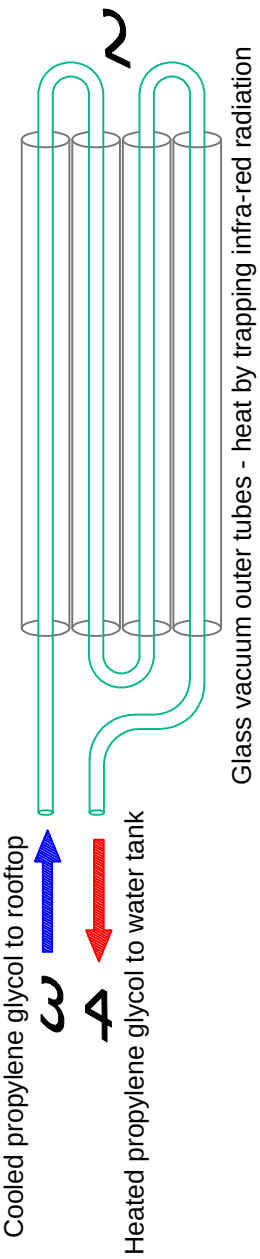
Jeremy and Pamela operate Puget Sound Solar , one of the premier installers of solar systems, both hot water and photovoltaic. Puget Sound Solar did the hot water installation in our home.

Home Power Magazine: a bi-monthly publication with information and ideas about powering your house more efficiently and greener.

SOLAR WATER HEATING SYSTEM

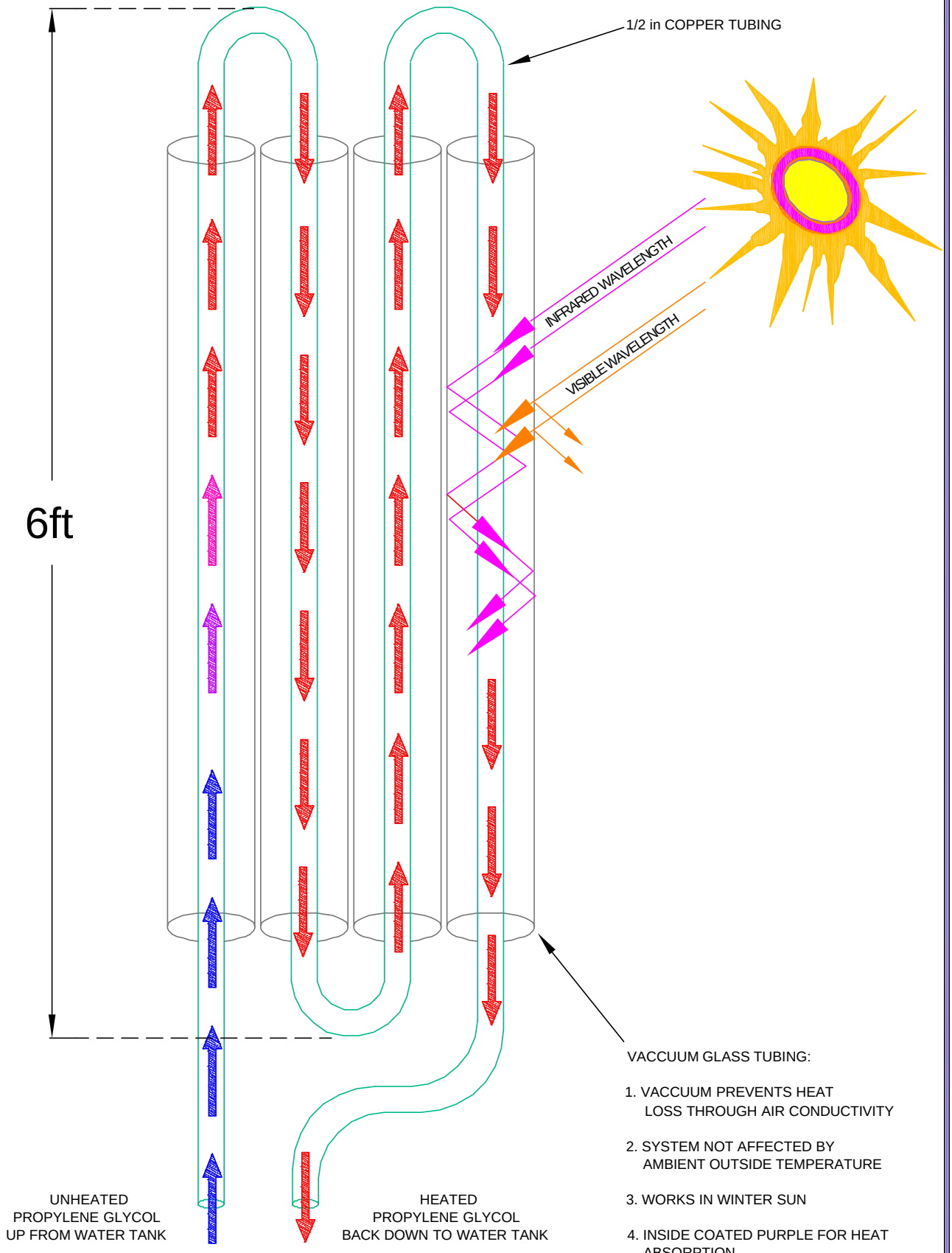


SCHEMATIC DIAGRAM
OF ROOFTOP COLLECTOR

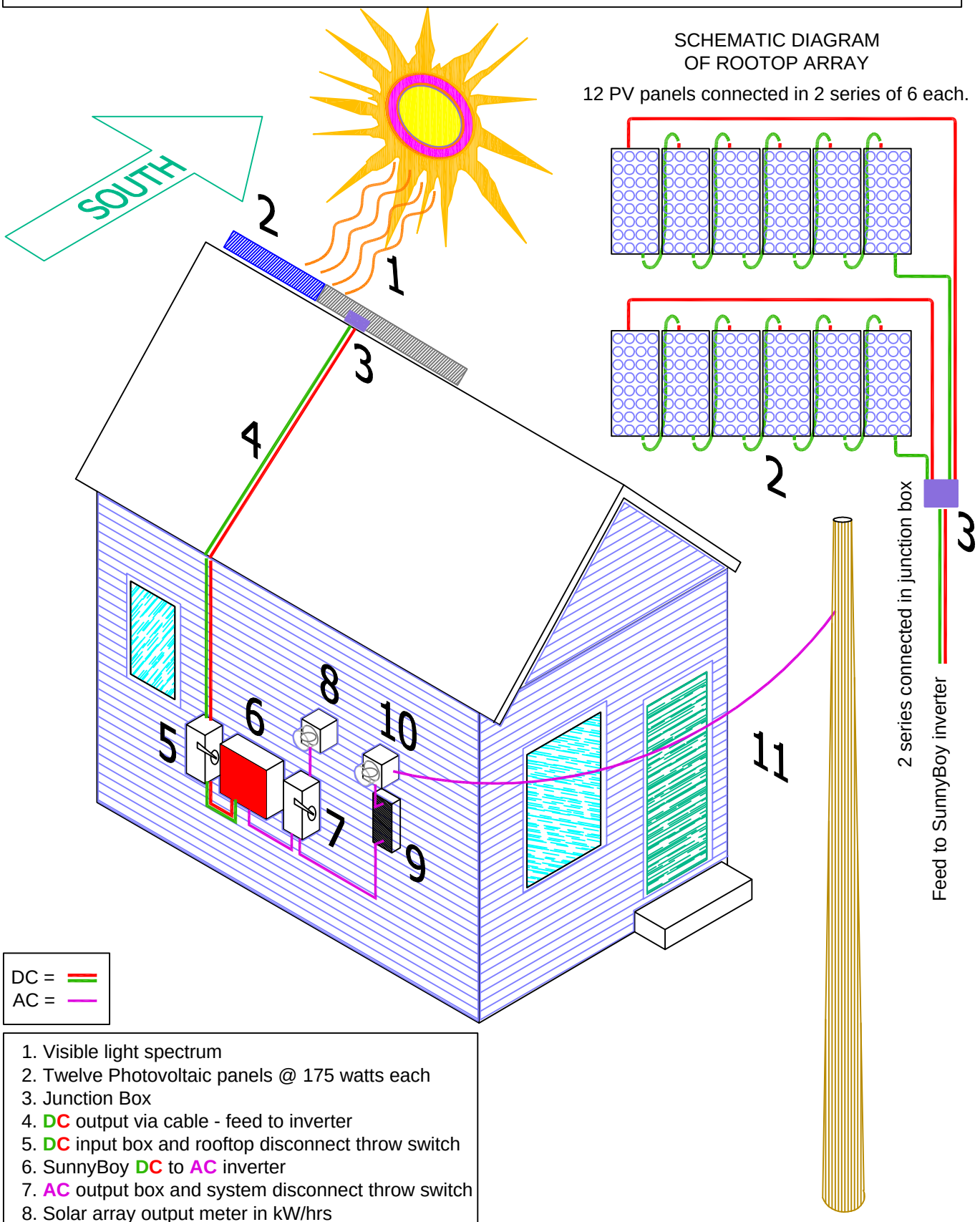


1. Radiation from the sun
2. Heat collector: propylene glycol in copper tubes inside glass vacuum tubes
3. Cool propylene glycol, pumped up to rooftop heat collector
4. Hot propylene glycol pumped from rooftop collector to heat exchanger coil
5. Pump and temperature regulator (mechanically, two separate items)
6. City water supply input
7. Solar "pre-heater" water tank (50 gallons) with heat exchange coil
8. Regular household water tank on City Light grid (50 gallons)
9. Domestic hot water output

HOT WATER ROOFTOP ARRAY

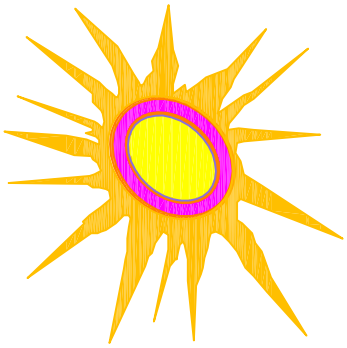


SOLAR PHOTOVOLTAIC SYSTEM

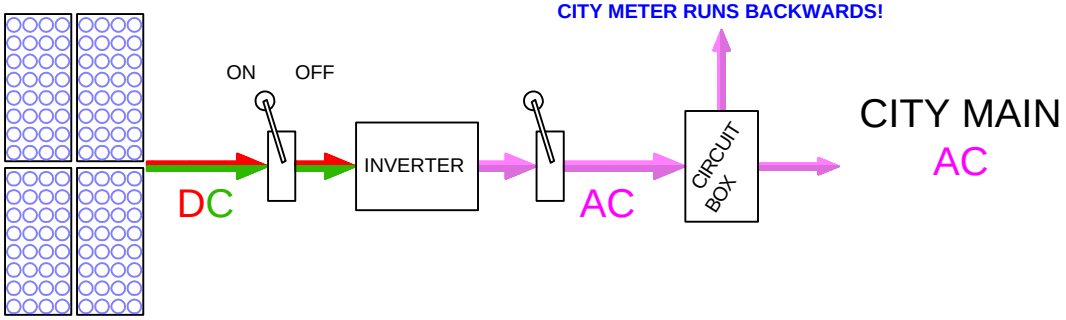


1. Visible light spectrum
2. Twelve Photovoltaic panels @ 175 watts each
3. Junction Box
4. **DC** output via cable - feed to inverter
5. **DC** input box and rooftop disconnect throw switch
6. SunnyBoy **DC** to **AC** inverter
7. **AC** output box and system disconnect throw switch
8. Solar array output meter in kW/hrs
9. Circuit breaker cabinet (inside house)
10. City Light **AC** input meter in kW/hrs
11. City Light **AC** input to house

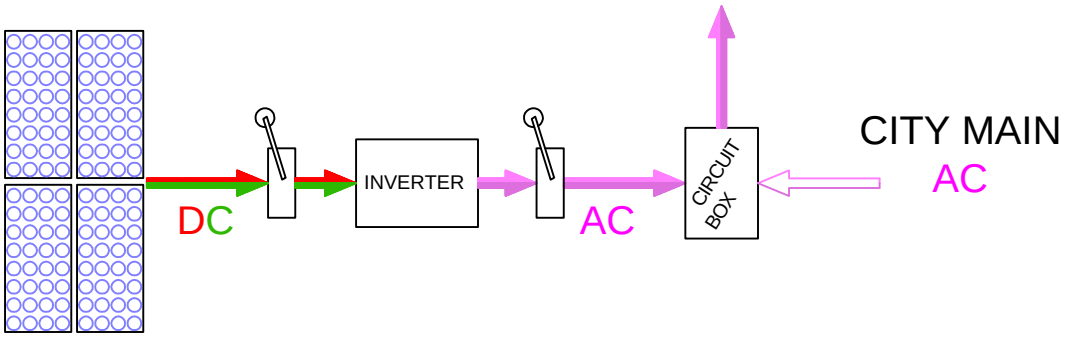
SOLAR PHOTOVOLTAIC OUTPUT



HOUSE DEMAND BELOW SOLAR OUTPUT
EXCESS FED BACK INTO CITY GRID
CITY METER RUNS BACKWARDS!



HOUSE DEMAND EQUALS SOLAR OUTPUT
NO CITY POWER USED



HOUSE DEMAND EXCEEDS SOLAR OUTPUT
CITY POWER USED
CITY METER RUNS FORWARD BUT MORE SLOWLY