Common Renewable Energy Terms and Concepts.

MONTEZUMA CLIMATE ACTION NETWORK

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for Montezuma Climate Action Network

January 22, 2009

(updated February 3, 2009

including correction of average home power usage.)

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Introduction

There are other Renewable Energy glossaries available on the Internet, but this one is intended to serve the dual purpose of glossary, as well as a sort of “Renewable Energy 101” for those of us who are starting from the beginning and want an overview.

I hope this serves both purposes for the M-CAN Hands On! Residential Renewable Energy group. This means the definitions and explanations are not intended to be for those studying the physics of renewable energy, but for those seeking a factual but intuitive understanding.

Terms are not listed alphabetically. Rather I've attempted to group them conceptually. If you're interested in PV electrical systems, those terms should be close together.

This will be a work in progress for some time. Contact me with corrections and suggestions at chris@foran.net.

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Electricity

Amp (Ampere)

The unit of measure for electric current. Measured with an ammeter (contraction of “amp meter” I feel sure).

Current is actually a measure of the rate at which electrons are passing through a wire (an Amp is 6.25 Billion Billion electrons per second). Measuring current is somewhat analogous to measuring rate of water flow through a pipe (such as gallons per second).

A 1KW 120 volt heater requires or “draws" 8.33 amps. Circuit breakers and fuses are commonly designated by the number of amps they allow through a circuit.

Volt

The unit of measure of electric “pressure”.

As with current, measuring voltage is somewhat analogous to measuring water pressure in a pipe. While water pressure is frequently measured relative to atmospheric pressure (IE, relative to the air we breathe), voltage is measured relative to “ground”. In a house electrical system, “ground” should actually be connected to the earth outside and is sometimes called “earth ground”.

AC and DC

These represent “alternating current” and “direct current”.

The meaning is that AC “vibrates” back and forth with the electrons first moving one way and then going back again the other way. The poor electrons hurry a lot and get nowhere.

On the other hand, DC means the electrons keep moving in the same direction.

Let me point out that the “C” in there means current, but the terms are frequently used to describe what kind of voltage is in a wire (as in “120 volts AC” and “12 volts DC”). You might think it should be AV and DV, but not so.

It should be pointed out that AC current and voltage can do real work just as DC amps and volts can. Nikolai Tesla designed the first AC generators and motors but was a poor businessman and Westinghouse bought his patents for a pittance.

Tesla had a laboratory roughly 10 miles south of Telluride, Colorado. It still exists, but is not open to the public. He also created the first AC hydro power station in Ames, Colorado, not far from his laboratory.

Watt

The unit of measure of electrical power.

In the simplest case, one watt is one volt times one amp at a point in an electrical circuit (Volts x Amps = Watts). So a light bulb with 120 volts and 0.833 amps will be using (or “dissipating”)

100 watts of energy because 120V x 0.833A = 100W.

To put things in perspective, 746 watts is one horsepower (though the definition of horsepower varies by industry and country).

See Reactive and Inductor for the reason the term "volt-amp" (VA) is sometimes used rather than "watt" in power generating terminology.

Kilowatt, Megawatt, Gigawatt

A kilowatt (KW) is 1000 watts, a megawatt (MW) is 1000 kilowatts and a gigawatt (GW) is 1000 megawatts.

Terawatts (TW) and petawatts (PW) are next but lets not go there.

Kilowatt-Hour

A kilowatt of power (used or generated) for one hour. A 100 watt bulb lit for 24 hours uses 2.4 kilowatt-hours of energy. Usually written KWhr.

Including (multiplying by) the time element means we are concerned with work (or energy) rather than just power. Power is measured at an instant in time while work or energy is spread over time and the amount of work depends as much on the time as on the power. Power x time = energy.

Circuit

A complete current conduction path from generator to load and back to generator.

Commonly used to mean the wire (conductor) through which electric current flows in such a path. The word "circuit" is used because the current must complete a "circle" from the generating source "hot" side to and through a "load" such as a light bulb or motor, then back through the "common" wire (or "ground" or "earth" meaning generally the same thing) to the other side of the generating source.

Current can only flow in the circuit when it is "complete". All series switches in the circuit must be closed to complete the circuit before current will flow.

Circuits can be more complex than a simple "circle" of conducting devices. For instance, in a "3 way" light circuit, there are several parallel paths (through different switches on opposite sides of a room for instance) through which the current can flow to the light bulb then back through the common wire.

Short

Simply means any unplanned connection in a circuit which allows the current to take a "short cut" without following the normal circuit path.

Accidentally allowing a wrench to touch both car battery terminals is definitely a short. Putting a knife into a toaster will likely cause a short and you may be part of it.

Power Generation and Use

Circuit breaker

A switch that opens an electric circuit when too much current flows in the circuit (possibly due to a short). The switch is operated electromagnetically. The circuit breaker contains an electromagnet which the circuit current must pass through. It is rated by and designed to be sensitive to a particular amount of current through the coil. As the current increases beyond the rating of the breaker, eventually the electromagnet will pull the switch open.

Transformer

AC voltage and current can be “transformed” to different voltages using electro-magnetic effects. DC electricity does create electromagnetism, but the DC electromagnetism is as constant as the DC current that creates it. A transformer depends on CHANGING electromagnetism.

If techno-babble puts you to sleep, jump to the last paragraph now.

Current through a wire causes an electromagnetic field in the surrounding space or substance. Likewise, electro-magnetic fields can actually create current (and voltage) in a wire IF the wire and field are moving relative to one another. The principle is used in motors and generators as well as transformers. This need for relative movement is why AC current is used in a transformer and DC would do nothing.

An electromagnetic field repeatedly spreads out into the space around a wire carrying AC current and then diminishes again as the wire's current diminishes. If the field “cuts” through a second wire nearby as it increases or decreases, it creates current in that “secondary” wire.

Transformers are built with the primary wire and secondary wire coiled tightly around a (usually iron) core. The wires are insulated so they don't short together. Coiling provides a lot of wire in a small space which makes a more dense electromagnetic field. The core is iron (or other ferrous material) because ferrous materials concentrate the electromagnetic field much more than most other common materials. The denser the field, the more power (current x voltage) can be transferred from the primary side to the secondary side.

Here's the secret to getting a different voltage on the secondary side; the number of coils of wire on the secondary compared to the primary (ratio of secondary to primary “turns” around the core) determines how much voltage comes out the secondary for a given voltage applied to the primary. A turns ratio of 2 to 1 creates twice the voltage.

Transformers are used in circuits as small as an iPod and as large as a power plant or substation. The “coil” used in your car's ignition system is a transformer. Almost every home has a transformer on a nearby power pole to reduce the many kilo-volts AC on the distribution lines down to 220VAC and 110VAC for use in the home. In general the larger the transformer, the more power it was designed to transfer through it.

Reactive

A term used in AC electricity to describe the way an inductive or capacitive load affects the phase of the current relative to the applied voltage. When the AC current and voltage are not exactly "in phase", in other words when the current and voltage are somewhat out of step, its usually because the load is reactive.

You will sometimes see this word attached to "volt-amps" as in "volt-amps-reactive" (VAR).

Inductor or Inductive

This term refers to a wide array of electromagnetic devices from AC generators and motors to transformers and various other "inductive" devices. Inductors most often involve a coil of wire around a metal (ferrous) core. Inductive devices are reactive (change the phase relationship of AC current to voltage).

The term arises from the idea of an electromagnetic field being "induced" by current in a wire as well as current being "induced" to flow in a wire by a moving magnetic field. The means of "inducing" from afar is a changing electromagnetic field.

An inductor "impedes" current flow when voltage is initially applied (hence the term "impedance"), but as a magnetic field is established and stabilizes, more current is able to flow. This causes circuit current to be delayed in phase relative to applied voltage. The term generally used for this effect is inductive reactance.

Mechanical inertia (as in a flywheel or a weight on a spring or a mass of water flowing through a pipe) is a reasonable mechanical analogy to electrical inductance. Just as the sudden closing of an open faucet can cause a shock to the piping system when all that moving water has to stop suddenly (water hammer), so the sudden opening of a switch in series with an inductive load can cause a sudden arc of electricity through the switch or any weak insulation in the circuit because the "flywheel" effect of the inductive load tries to keep the current flowing. See Capacitor or Capacitive below for more "water hammer" analogy.

Capacitor or Capacitive

A Capacitor is a simple device used in circuits from small electronics to grid electrical power circuits. It's simple purpose is storage of electricity. It's circuit effect is to change the phase of current and voltage in the opposite polarity from an inductive load.

A capacitor, however, does not usually replace a battery (there are some exceptions such as the new "super" capacitors) but instead is generally used for very short term storage, such as during a single cycle of AC electricity or (in your watch, digital camera or PC) long enough to allow a battery to be changed without losing information in the memory devices for which the battery provides power.

Jump to the last paragraph now if you're feeling sleepy.

The construction of a capacitor involves two "plates" separated by a thin insulating layer. The plates may be thin foil sheets separated by thin plastic and this "stack" may be simply rolled into a cylindrical shape. There are other forms of capacitor construction.

The principle is that electrons forced onto one of the plates will repel the electrons on the adjacent plate, which essentially creates a negative charge on the first plate relative to the other. For the short time it takes to force the electrons onto one plate and off of the other, it appears that current is flowing through the capacitor. This is similar to current flowing "through" a battery when it is charged or discharged. Like a battery, a capacitor can remain charged if disconnected from the circuit by some means (a switch or transistor for instance).

Because there is always a load in line (in series) with a capacitor, such as a resistor, a motor coil, a light bulb or even just a wire (which has some resistance to current flow), the capacitor at first looks like a wire because current flows into it freely. But as voltage builds from one plate to the other, the capacitor looks less and less like a wire and more like a current impediment. The result is that the entire circuit "reactance" allows more current early and less later in an AC cycle, causing circuit voltage to be delayed relative to current.

Combining a capacitor with an inductive load in a circuit in the right way can cause their reactance to cancel. See Power Factor below.

Filling a balloon with water through a partly open faucet is a reasonable hydraulic analogy to charging a capacitor through a somewhat resistive DC circuit. If the water pressure is too high (or balloon too weak) the balloon will eventually burst. If the voltage is too high for the capacitor rating, the capacitor can fail and short through the insulating layer.

Another analogy that works well is to think of a "hammer damper" in a piping system. The hammer damper is a short closed piece of pipe full of air that is T mounted vertically to a run of home water piping. Because the damper is a vertical dead-end, the air cannot escape. When a faucet is suddenly closed, the moving water compresses the air which cushions the water hammer effect. In this same way, a capacitor can be used to damp the shock of opening a switch to stop the flow of current through an inductive load (such as a motor).

Phase or Power Factor - Including PF Correction

Inductive loads in a circuit, such as motors, can cause the current and voltage to be somewhat "out of phase" from one another. How much out of phase is indicated by the "power factor" (PF) which is simply a fractional number between 0 and 1 indicating how far out of phase the sinusoidal current and voltage are. It is technically the cosine of the angle between the sinusoidal current and voltage.

A power factor of 1 indicates they are perfectly in phase and 0 would mean completely out of phase. A PF of 0.5 represents a large phase error in reality.

The way an inductor or capacitor can change the current-voltage phase in a circuit can be an advantage in electronic devices such as radios. In electric power technology, however, it is usually a problem. See Power Meter below.

The extra current that flows if the PF is less than 1 will cause more line losses in the grid coming to the meter than if the PF was 1.

The voltage-current phase delay caused by inductive loads is why the term "volt-amp" (VA) is sometimes used rather than "watt" when discussing grid power. The term "reactive" comes into play, for example "volt-amp-reactive" or VAR is a measure of the (vector) difference between VA and watts when the PF is not 1. Non-zero VAR means a difference between VA and Watts and indicates a power factor problem.

Most electrical rate tariffs contain provisions that include a minimum power factor. Customers who fall short of the minimum power factor level receive a power factor charge.

For this reason, the power supplier (your coop) will generally apply a surcharge if there is a large phase difference (low PF) at your meter. The PF that triggers a surcharge is generally anything below 0.85 or 0.90. Power Factors less than 90% are primarily a problem for industrial users with many (or large) motors. These industrial customers generally will install capacitors near their motors to correct the problem and avoid extra charges.

Power factor correction is rarely needed by or effective for residential customers.

Meter - Power Meter

Your meter measures (and accumulates a total of) the instantaneous power used by your home. That is, the meter multiplies current times voltage at every instant throughout every cycle of AC electricity and adds it all up.

If the sinusoidal voltage and current are somewhat out of phase, the accumulated power measured is less than if the same amount of current and voltage were perfectly in phase.

This means that being out of step results in more actual current flowing through your meter than the meter's power measurement would indicate if there was no phase difference. You're not getting away with anything in this case, because your home is really only getting the benefit of the power registering on the meter. Instead, the power company is losing power in the grid because of the customer's phase problem.

House Power

The average American home used 920 KWhr per month during 2006, (see this U.S. Energy Information Administration site). The Colorado average in 2007 was 710 KWhr per month. The average month is 730.5 hrs, so Coloradans use 710/730 = 0.97KW average 24hrs per day 7days a week. If your house did nothing but burn 10 100watt bulbs continuously 24hours a day, you would use just over the Colorado average amount of power.

The average home receives both 110 volts AC and 220 volts AC from a transformer located very close to the house. This transformer reduces the voltage from the multi-kilovolt level AC on the grid.

You will sometimes see the 110 VAC referred to as 115 VAC or 120 VAC. This is because the voltage does vary a fair amount on the lines and into your house without harm. 100 VAC to 130 VAC is not uncommon and 115 VAC is nominal. The same variation is true of the 220 VAC, which is always twice the 110 in your house.

Both 110 and 220 are supplied because certain household items, such as the clothes dryer and electric stove, waste less power if they are designed to operate from higher voltage. The 220 VAC is actually two out-of-phase 110 VAC circuits. Appliances using 220 VAC are designed to use both phases of 110 VAC to supply the 220 VAC.

A subtle effect of this standard dual household voltage arrangement is that roughly half of the 110 VAC circuits in your home may be “out of phase” from the other half. That is to say, the direction of the electrons is out of step from one circuit to the other.

Well, who cares what direction they're going? It means that the voltage at any instant in the two circuits are of opposite polarity and if you measured the voltage from one circuit's “hot” wire to the other circuit's “hot” wire, you would measure 220 VAC. This is twice what most of your household stuff can stand. Fortunately, no 110 VAC residential appliance or gadget is ever designed to plug into two different sockets at once, so you can't apply voltage from two different circuits to the same 110 VAC appliance.

Geo-Thermal Power

Geo-thermal means literally “earth heat”.

A number of power plants have been built around the world which use the heat from deep in the earth to create steam to drive turbine generators. How deep the pipes have to be in the earth to find high enough temperatures depends greatly on the local geology. Yellowstone should provide high heat very close to the surface.

Sometimes mistakenly applied to ground source heating. See ground source heat pump.

Electricity Generation at Home

PV or Photo Voltaic

PV refers to generating electricity directly from sunlight, using panels made (usually) of silicon.

Silicon PV panels are most commonly built up of many small silicon solar cells. In a residential setting, the panels are frequently mounted on the house roof at roughly an angle (above the horizontal) that is at least as much as your latitude (the angle North the equator of your location which is 37 degrees for Cortez, Co.).

The panels vary in size, but are frequently several feet on a side (even 4' X 8' or more) and usually require strong mounting brackets.

An array of silicon cells are mounted on a backing to create the large panels. The cells are most commonly made of crystalline silicon. Silicon wafers were first used as solar cells by Bell Labs in 1954.

The wafers (cells) are thin slices sawed from large silicon crystals. The large silicon crystals are created by slowly “pulling” them from molten silicon. These wafers or slices are also the raw material used to make integrated circuits in our electronic gadgets. In spite of the fact that silicon is a very common substance (sand) and because it requires special equipment to create the very large crystal wafers and because the wafers are in demand by the electronics industry, the panels have been fairly expensive. The panels (new) may cost 4-5 per watt they generate.

See House Power for average home power use.

Of course, if you were installing a PV system to run your house, you would account for the fact that we actually use power in short bursts of many more watts than the average numbers and that the sun shines less than half the time, so you need more watts of solar panels. A 2 kilowatt residential installation is not excessively large, but smaller installations may well do the job for you. Thus the PV panels alone may cost (today) as much as $10,000.

As a result of recent research, PV solar panels are now being made of less expensive materials as well. Prices are expected to drop much lower in the near future.

One alternative to the mono-crystalline silicon is the less expensive but less efficient polycrystalline silicon. Nano-technology is having a big impact on PV research.

Grid Tied

Refers to a renewable electricity system which is tied to the normal electricity lines so that electricity is supplied to the home or business by the renewable system to some extent, with any excess needs being met by the power lines. If excess is generated by the system, it is sent out onto the grid for use by others.

In a grid tied system, there are no batteries required to store the electricity (see Off Grid below), which is a cost savings. However, a grid tied system requires a device called an inverter which transforms the low voltage DC electricity from the renewable source to the higher 110/220 volt AC to feed the house or lines.
The homeowner pays the power company for the difference if more power is used than generated, but the power company pays the homeowner if a net excess is generated. A special meter is required for a grid tied system so power can be measured going in and out of the system to give a net difference.

Off Grid

Refers to a renewable electricity system which is self contained, meaning that the system is not connected to the normal electricity lines (grid), but generates all the electricity needed by the home or business it was designed for. Batteries are a significant feature of an off grid system because renewable energy is rarely available during all the hours when electricity is needed, so it must be stored. Normal lead-acid batteries like those used to start your car could be used, but don't have the endurance in this application that deep-cycle lead acid batteries have.

The home appliances may be AC powered as in grid powered homes. Some or all may be low voltage DC powered. These DC appliances are available, partly because many RV appliances will operate on low voltage DC electricity. If the appliances include AC powered ones, then an inverter and separate house wiring for those is required, though the inverter may be of modest size if some loads are DC, such as lights or refrigerators.

Inverter

An inverter Is a (usually) electronic device designed to create AC electricity from DC.

Small and inexpensive inverters such as those available in local stores for powering your radio, PC or power tools from your car battery are likely to generate non-sinusoidal or impure sinusoidal AC power. This may be satisfactory for the intended use, but will not do for most residential power systems.

Additionally, the inverter for a home will need to be sized appropriately for the particular system and home. For a grid tied system, the inverter will need certain safety features, some of which are required by the power company to protect their linemen.

Micro Hydro

A small turbine generator using the force of water flowing downhill to generate electricity. See www.microhydropower.net/ for information.

Fuel Cell

A device that converts the chemical energy of fuels directly into electricity.

The most common fuel used in fuel cells today and discussed for the renewable energy economy is hydrogen (symbol 'H'). H is the most abundant element, "*constituting roughly 75% of the universe's elemental mass*" according to Wikipedia. In its gaseous form, hydrogen is chemically H2.

A hydrogen fuel cell combines gaseous oxygen (O2) and hydrogen (H) to create electricity and water.

Although hydrogen is the most common element, it is not available readily in its pure form. The most common way of acquiring pure hydrogen is to separate water into its elements, oxygen and hydrogen. Because energy is expended to separate waters elements, the hydrogen is considered a means of storing energy rather than a primary source of energy. The fuel cell is simply the means of finally releasing the energy that hydrogen has stored until we need it.

Wind

Usually refers to generating electricity using a windmill to drive a generator or alternator much like those keeping your car battery charged. Home-made wind generators frequently use car generators or alternators.

In general, the higher the wind turbine is above surrounding objects, the better performance it will provide.

Home Heating

BTU

British thermal unit: One BTU is the amount of heat required to raise one pound of water one degree Fahrenheit. Technically this applies only at one "atmosphere" of pressure.

The BTU measure of heat is defined using water as a standard, but applies to the measuring of heat in any substance - air for instance.

Heat and temperature should not be confused. Heat is the energy of the molecules making up the material... that means how active the molecules are in moving and vibrating around. More active means more heat and less active means less heat. Temperature is the average energy in a volume while heat is the sum of all the energy in that volume. This is so for any volume of any material we're measuring the heat in.

A gallon of water at some temperature contains four times the heat that a quart of water at the same temperature contains. Thus larger tanks of water can store more heat than smaller tanks at the same temperature.

It is also true that one gallon of water at 200 degrees contains twice the heat of a gallon at 100 degrees (F or C).

Insolation (not insulation)

Means solar radiation striking a surface. The amount of insolation your area receives determines how suitable solar energy systems are for your use. Here's a map of insolation across the U.S.

Passive Solar (Heating)

The simplest means of heating your home, this involves using the sun to heat your house directly. This method does not use solar panels on the roof, so no pumps or electronic controls (thus “passive”).

Passive solar works best if your house faces south, has significant windows on that side to let the sun in, is very well insulated and sealed and has some means to absorb much of the sun's heat (such as a concrete floor or “trombe” wall).

A significant detail is that the south wall with the windows should be vertical and should have an overhang of the right length and height above the floor to provide shade in the summer when the sun is high yet allow the lower winter sun in to heat the house.

An eight foot vertical window wall with a two foot overhang works well at the latitude of Montezuma County, Colorado. If the wall is taller, the overhang should be proportionately longer.

Variations in these proportions can affect how well the house heats during the transition seasons of spring and fall. In the spring, the sun begins to rise in the sky before the weather catches up (warms up). This may mean that your house will be a little cooler than you might want during Spring. Likewise, the house may be warmer during Fall than you would like. The proportions given provide enough heat that pull-shades can be used to control excess, allowing greater Spring/Fall comfort.

Solar Hot Water

This term has several meanings:

a) Usually refers to domestic hot water (replacing or supplementing the normal hot water heater for showers and faucets). The water is heated in insulated panels (usually on the roof) with internal piping covered by a glass sheet. A pump is used to circulate water from a tank to the panels to be heated by the sun, then back to the hot water tank. Usually requires a controller (thermostat) to control when the water in the panel is hot enough for the pump to run. Most systems include conventional means of heating the water when sunlight is not enough. For this reason, when adding solar domestic hot water heat to an existing system, the original hot water heater could still be used.

b) Could also refer to heating your home with water heated in panels on the roof much like the domestic water heating. A home heating system differs from a domestic hot water only system in that you will also require:

- much larger water tank – sometimes also serves as the domestic water tank
- more roof panels
- a means of distributing the heat to various rooms (such as radiators or radiant floor heat with thermostats and pumps)
- usually uses a water and anti-freeze mixture in the panels
- the tank usually contains pure water isolated from the antifreeze by heat exchangers.
- can use plain water in the panels if a "drain-back" arrangement is used to prevent freezing at night.

Heat Pump

Much of the US uses heat pumps to heat and cool residences. This is a technology very similar to your refrigerator, but a heat pump is large enough to refrigerate (or heat) your entire home.

A heat pump (and refrigerator) has a compressor, an inside radiator and an outside radiator as well as miscellaneous valves and a reservoir for a supply of refrigerant gas. The radiators are commonly called coils.

The principle of heat pumping is based on the fact that a gas that is compressed into a smaller volume becomes hotter as a result. The temperature rises, not because compressing the gas creates more heat but because the heat in the gas is now concentrated in a smaller space. The energy in each square inch is now higher, so the temperature is higher (see BTU for a discussion of heat vs temperature).

In a refrigerator:

1. The cool gas absorbs heat as it passes through the inside radiator.
2. The gas is compressed to raise its temperature.
3. The compressor sends it through the outside radiator where it loses much of its heat (including what it absorbed inside when it was much cooler). The heat is transferred to the air in your house.
4. Still compressed, but now cooler and condensed to a liquid, the refrigerant is released through a small hole back into the lower pressure inside radiator.
5. This allows it to return to its gaseous state which drops its temperature. This takes us to the top of this list and completes the refrigeration cycle.

This explanation omits some details but is correct in principle. The refrigerant gas is used because of the temperature at which it changes from gas to liquid. It condenses to a liquid in the outside radiator as it cools off which causes it to give up more heat. Condensation makes this refrigeration cycle much more efficient than if the refrigerant remained a gas during the entire cycle.

A heat pump for your home works exactly the same as a refrigerator, but with the added feature that it can reverse the roles of the inside and outside radiators to heat your home in the winter. The outside radiator is, of course, outside your house.

One limitation of an air-to-air heat pump in winter makes it less suitable for use in very cold climates. That is the limit of the coolest outside winter air temperature in which it can still extract heat to warm your home. New heat pump technologies have extended that temperature somewhat lower than the previous 25 degrees Fahrenheit which kept it from being useful in Colorado.

Ground Source Heat Pump

The ground source heat pump works the same as any other heat pump but with the outside coils being buried in the earth (sometimes sunk in a big enough body of water) to take advantage of the relatively constant temperature of the earth (roughly 45 degrees Fahrenheit). This allows heat pumps to work in very cold environments as long as the coils are deep enough to avoid the freeze line by a good margin.

So instead of extracting heat from the air to heat your home, a ground source heat pump extracts heat from the ground. Like other heat pumps, it can reverse the process to cool your home in summer.

Geo-Thermal Heating

Means using heat directly from the earth, usually in geologically active regions where high heat is near the earth's surface. Water heated in the earth or steam can be piped around to heat industries, businesses and residences. Sometimes even used to melt snow from roads and streets.