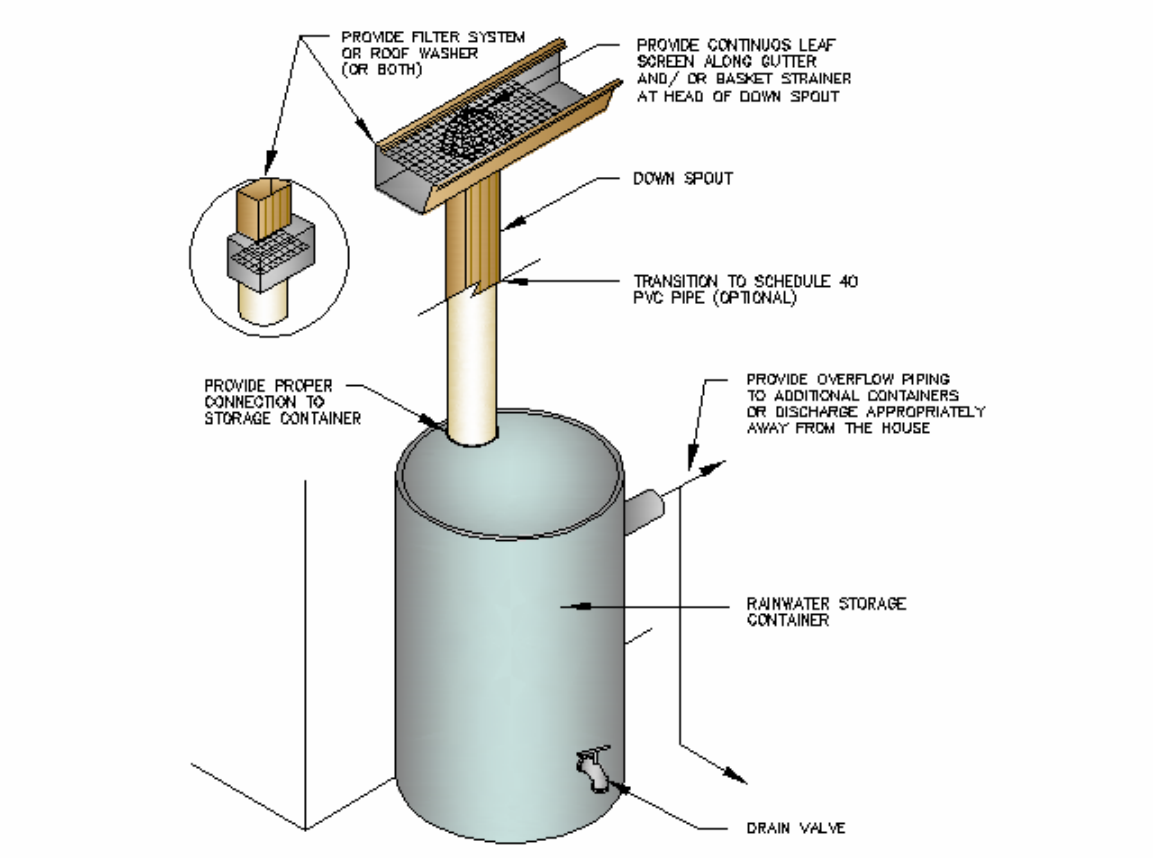
<u>Water Efficiency:</u>
Rainwater Harvesting System:

What it is: "Rainwater harvesting is the capture, diversion, and storage of rainwater for landscape irrigation and other uses." (1) "The collected water can be used for small scale irrigation (of vegetable gardens etc.), clothes washing, bathing and after treatment also for drinking and food preparation." (2) A storage cistern/tank can either be above or below ground. One of my sources suggested that diverting rainfall to "plants located at contoured low points" is also a form of rainwater harvesting that doesn't require storage. (3)

Note: Rainwater harvesting as used for the irrigation is the subject of the pros and cons below.



picture: (9)

Pros:

- "Reduces off-site flooding and erosion by holding rainwater on the site." (1)
- "Reduces dependence on groundwater and the amount of money spent on water." (1)
- "Rainwater harvesting systems are integrated with the house which makes the water easily accessible." (2)
- "Free, literally falling from the sky and unhindered by government regulations, harvested rainwater splendidly augments domestic water resources." (2)

- “Rainwater is soft and doesn't cause buildup of scale in water heaters, plumbing lines or household humidifiers.” (4)
- “Rainwater does not stain laundry and plumbing fixtures (no iron or manganese).” (4)
- “[Rainwater] is better for landscape watering than waters that are naturally alkaline or rich in sodium.” (4)
- Maintenance is simple if the water is not used for drinking. (4)
- “‘Rainwater harvesting is a great way to control a lot of on-site drainage,’ says Mike Chapman, a home builder in Santa Fe, N.M. ‘We don't have to deal with runoff from roof water because it gets siphoned-off into the holding tank.’ By lowering the amount of peak runoff, a smaller, and potentially less costly, stormwater management system can be put in place.” (5)
- “Reduced water and sewer costs. In most urban communities, sewer costs are based on water usage. By capturing rainwater and reducing water purchased for landscaping, homeowners can also save money on their sewer bills. In Arlington, Va., for example, homeowners will save about $3 on water fees and $4 on sewer fees for every 1000 gallons of water captured and used for landscaping. This can save the average homeowner $600 per year.” (5)
- Rainwater harvesting has great potential in Florida because of the large amount of rain the Florida receives during the year. “Sarasota, Florida [is] an area that typically gets over 50 inches (127 cm) of rain a year.” (6)

Cons:

- The homeowner is dependent upon the consistency of rainfall to meet water use needs.(3)
- Storage would need to be large enough to hold rain through heavy rain seasons over into the dry seasons. (3)
- Cost of materials and labor. (7)
- Buried cisterns are susceptible to unnoticeable leaks, root damage (from nearby trees), and damage from heavy vehicles driving over the cistern. (7)
- Tanks (especially those are buried) can be expensive. “About one dollar per gallon is the average cost for most underground storage units.” (3)
- “Rain in certain urban areas may contain various impurities absorbed from the atmosphere, including arsenic and lead.” (3)
- “Rainwater is naturally acidic, and corrosive to metal tanks and household plumbing. In homes where the water lines are copper, joined with lead-containing solder, the rainwater should be neutralized before it enters the water lines to prevent mobilizing lead and copper into drinking water.” (4)
- The larger the roof surface, the economical a rain harvesting system becomes. (8)
- Use of rain-harvested water for use other than irrigation is also regarded as non-economical. “Treating rainwater to a high standard, suitable for bathing or even for drinking, is not something we would recommend. Not only is it very expensive, but also the impact of all the equipment that you would need would outweigh any environmental benefits of reducing mains water use. Small-scale

water treatment systems use lots of energy in manufacture and use, and the filters need to be regularly replaced - so creating waste." (8)

Note: Http://www.harvesth2o.com/index.shtml has a good comparison of storage options for rainfall harvesting.

Sources:

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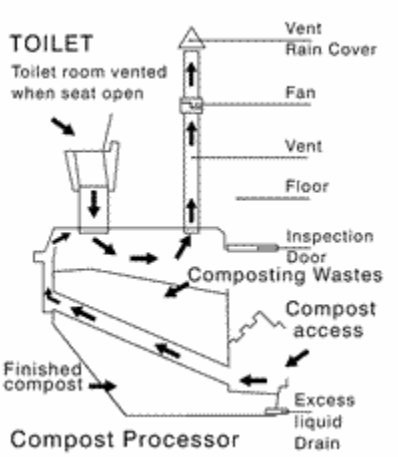
Waterless/Composting Toilet:

What it is:

"A composting (or biological) toilet system contains and processes excrement, toilet paper, carbon additive, and sometimes, food waste. Unlike a septic system, a composting toilet system relies on unsaturated conditions where aerobic bacteria break down waste. This process is similar to a yard waste composter. If sized and maintained properly, a composting toilet breaks down waste 10 to 30% of its original volume. The resulting soil-like material called "humus," legally must be either removed by a licensed septage hauler in accordance with state and local regulations." (1)

There are two types of composting toilets, a large "bi-level, watertight container equipped with a chute that connects the toilet receptacle to the composting unit located in the basement" and a small unit "in which toilet receptacle and composting tank comprise a single self-contained unit located in the bathroom." The appropriate type of composting toilet will depend on the desired capacity and maintenance level. (2)



pictures: (8 and 9)

Pros:

- "Composting toilet systems do not require water for flushing, and thus, reduce domestic water consumption." (1)
- "It is more cost-efficient to treat waste onsite than it is to build and maintain a central sewer system to which waste will need to be transported." (1)
- "These systems reduce the quantity and strength of wastewater to be disposed of onsite." (1)
- "They are especially suited for new construction at remote sites where conventional onsite systems are not feasible." (1)
- "Composting toilet systems have low power consumption." (1)
- "[Composting toilets] come in a selection of power choices, including non-electric, 12VDC battery and 120VAC electric." (3)
- "Self contained systems eliminate the need for transportation of wastes for treatment/disposal." (1)
- "Composting human waste and burying it around tree roots and nonedible plants, keeps organic wastes productivity cycling in the environment." (1)
- Composting toilet system can accept kitchen wastes, thus reducing household garbage. (1)
- "In many states, installing a composting toilet system allows the property owner to install a reduced-size leach field, minimizing costs and disruption of landscapes." (1)
- "Composting toilet systems divert nutrient and pathogen containing effluent from soil, surface water, and groundwater." (1)
- There is minimum site disturbance involved in the installation of a composting toilet. (4)
- "Smaller, self-contained units are less expensive, easier to install and can usually be retrofitted into existing dwellings." (2)
- "Compared to self-contained units, bi-level composters have a large compost volume and long retention time. Thus, the composting process is more stable than in smaller units, is better able to cope with peak loads, and can withstand

intermittent or seasonal use. Finished compost generally need only be emptied annually or once every several years." (2)

Cons:

- "Maintenance of composting toilet systems requires more responsibility and commitment by users and owners than conventional wastewater systems." (1)
- It is likely that a contract with the manufacturer will be required for regular maintenance. (2)
- It may even be necessary for the manufacturer or a septage hauler to remove end-products to "reduce exposure of the owner and the public to potential pathogens." (2)
- "Removing the finished end-product is an unpleasant job if the composting toilet system is not properly installed or maintained." (1)
- "Composting toilet systems must be used in conjunction with a graywater system in most circumstances." (1)
- "Gray water and the composted waste [will need to] be disposed of separately."(5)
- "Non-electric models will generally have the lowest capacity and AC Electric models will have the highest." (6)
- "Using inadequately treated end-product as a soil amendment may have possible health consequences." (1)
- "Too much liquid residual (leachate) in the composter can disrupt the process if it is not drained and properly managed." (1)
- "Most composting toilet systems require a power source." (1)
- Composting toilets range from $1,000 to $5,000. (7)
- "Smaller composting units have a shorter residence time with the result that waste may not be fully decomposed before it is discharged, the unit must be emptied more frequently and there is greater potential (and less storage capacity) for liquid accumulation if the unit is overused." (2)
- "All small composting units intended for regular, year-round use should be equipped with several devices to ensure that they function properly." (2)

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2. http://www.barnstablecountyhealth.org/AlternativeWebpage/Composting/Composting.htm
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7. http://www.grist.org/advice/ask/2005/11/21/toilets/
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Low-Flush Toilets:

Low flush toilets are generally defined as using 20% less water than conventional toilets. (1)

Dual-Flush Toilet:

What it is:

Dual-flush toilets allow the user to select one of two flushing options – 0.8gpf for liquid waste or the standard 1.6gpf for solid waste. (2) Some toilets have a two button system (1), and others utilize a handle that can be pushed down or lifted up for either flush option. (3) "Most dual-flush toilets operate with a fairly conventional gravity-flush technology, though the Kohler Power Lite models are powered by a pump, and the Mansfield EcoQuantum has a pressure-assist flush mechanism." (3)




pictures: (1, 5 and 7)

Pros:

- Manufacturers like Caroma first designed dual-flush toilets for water conscious Australia, so their toilets have the benefit of meeting the strict performance needs of the Australian marketplace before being introduced in the U.S. (4)
- Dual-Flush toilets use just one gallon for an average flush (much less than the older 3-5 gpf toilets) (1 and 5)
- A comprehensive evaluation completed by the Canada Mortgage and Housing Corporation (CMHC) and Veritec Consulting of Ontario, Canada showed that the dual flush toilets used 23 to 32 percent less water than the conventional 1.6 gpf toilets. (6)
- This same study mentions that the shorter flush was used more than the longer flush, suggesting that the shorter flush option has a lot of water saving potential because of it's frequency of use. (6)
- As with an increasing number of toilets, dual-flush toilets are appearing with more efficient alternatives to the traditional flapper value, which is prone to failure and leaking. (5 and 7)
- Many of the models offered have around a 4-inch trap (much larger than older toilets), with helps with draining and prevents clogs. (5)
- The plastic materials used are recyclable and vitreous china has a number of second life applications. (4)
- When testing two types of water saving toilets, the EPA found the dual-flush toilets to be the more economical option over the 1.1gpf model toilets. (2)

Cons:

- Dual-flush toilets can have a high initial price depending on the model and whether the tank/base is made of vitreous china or a tough plastic. (5)
- "Some toilets have sharp edges in their drains that catch toilet tissue as well as items people drop in toilets, such as makeup pencils, pens and toys. For that reason, shop for toilets with smoother edges around the drain and more sweeping traps with gently angled drains. They simply perform better." (1)
- Dual-flush toilets also have a smaller waterspots which may not clean the bowl as well as other toilets. (9)
- If these toilets are used in public facilities, there may be a certain amount of user education (through signage?) to prevent confusion or misuse. (8)

Note: The Saving water Partnership in Seattle has developed a "FlushStar list" to help the consumer choose a good toilet model. "The FlushStar list is based on water savings for the utility [and the] toilets have been evaluated through independent testing. They were shown to provide better flushing performance and are designed for more reliable water savings." This list can be accessed through their website. (9)

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7. http://www.buildinggreen.com/auth/article.cfm?fileName=141110a.xml
8. http://www.environment-agency.gov.uk/subjects/waterres/286587/286599/286911/548861/862887/?version=1&lang=_e
9. http://www.savingwater.org/inside_bathroom_toilets.htm

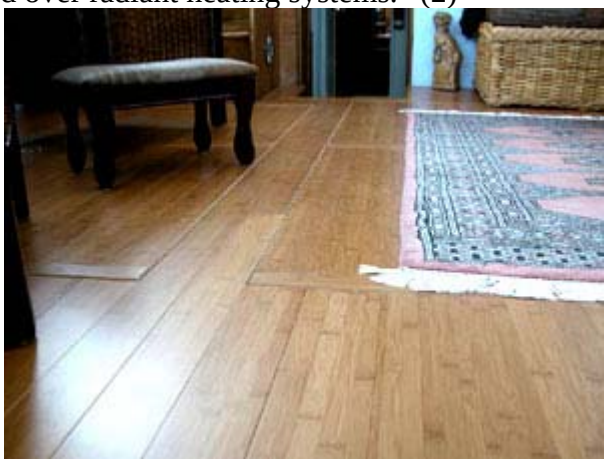
Eco-friendly Flooring Materials

Bamboo Flooring:

What it is:

"Bamboo is harvested, sliced into strips, boiled in water with a preservative, and pressed flat. It is then laminated vertically or in three horizontal layers, and kiln-dried... Bamboo flooring products are manufactured in varying dimensional tongue and groove strip sizes and lengths. These products are available either pre-finished or unfinished, and they are usually offered as either natural or amber colored. Costs range from $4 to $8 per square foot for higher quality products." (1)

“Bamboo floors can be nailed, glued, or floated depending on the type you choose and your particular housing needs. Solid bamboo flooring must be nailed or glued to the subfloor; however, engineered flooring can be "floated." This means that the planks are glued together at only the edges rather than to the subfloor. Floating floors can be installed over radiant heating systems.” (2)




pictures: (5)

Pros:

- “According to manufacturers, bamboo flooring should last a lifetime (30 to 50 years). The onetime costs of installing bamboo flooring should be less than the costs for multiple installations of less durable flooring options. Therefore, over the long-term, the consumer should save money. Replacing the flooring generates waste, so reducing the rate of replacement also reduces waste generation.” (1)
- “Bamboo... is 13 percent harder than maple and 27 percent harder than northern red oak, so it lasts longer and can withstand more use than conventional hardwood floors.” (3)
- “[Bamboo] floors are naturally resistant to water, mildew, and insects...” (3)
- Bamboo is often favored as a highly renewable source because it can be harvested in “3-5 years versus 10-20 years for most softwoods.” (4)
- “Solid floors (solid bamboo) are less expensive to produce than engineered flooring, and therefore, cost less. Also, the fact that they are 100% bamboo makes them more environmentally appealing. On the other hand, manufacturers claim that engineered floors (surface layer is bamboo and the bottom layers are made of another type of wood) provide for extra stability and that they can better accommodate expansion due to temperature/humidity changes by use of expansion gaps in the core layer. Regardless of your choice, ensure a plank thickness of at least 5/8" for a more stable and durable floor.” (2)
- Bamboo floor maintenance is just like that for any other traditional hardwood flooring. (5)

Cons:

- "[Some mills may] use poor-quality adhesives, often-made right there at the mill. These glues may not resist water well and may contain high levels of urea-formaldehyde, which off-gases in the home." (6)
- "Since most bamboo for flooring originates in the Asian Pacific Rim, the question of fair labor practices is a legitimate concern in the production and manufacture. To date, these practices have not been well documented. As a result, local product distributors may not have much direct control or be willing to say much about this issue." (1)
- "Floors manufactured using the horizontal orientation may be prone to cupping, but this problem is eliminated when the center layer is oriented perpendicular to the top and bottom layers." (1)
- "Nearly all bamboo for flooring is grown and manufactured in the Pacific Rim, generally in China or Vietnam. Therefore, any life-cycle analysis of these products should take into account both energy consumption and air emissions resulting from the transportation requirements of bringing the bamboo to market." (1)
- If bamboo flooring mills do not kiln-dry their material to a low enough moisture content (6-8% was suggested by EcoTimber), the bamboo may be unstable during seasonal humidity fluctuations. (6)
- Bamboo flooring can be purchased either pre-finished or unfinished. If the manufacturer uses something other than non-toxic aluminum-oxide, you may want to find out if the finish contains VOC's. (2)
- Because of its rapid renewability, however, "some manufacturers are harvesting bamboo before it is mature enough to produce good quality, hard flooring planks (4 years of growth is recommended). Flooring that is made from these immature poles is soft and may easily warp, dent, and delaminate." (2)
- Bamboo flooring may change color over time due to UV exposure, but some bamboo flooring is available with UV protective finishes. (7)

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2. http://www.portolavalley.net/building/bpe_greenbuilding_bamboo.shtml
3. http://www.coopamerica.org/pubs/realmoney/articles/flooring.cfm
4. http://www.bamboocentral.org/index1.htm
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7. http://www.pandabamboo.com/warranty.htm

Polished Concrete Flooring:

What it is:

Polished Concrete is exactly what its name suggests. The concrete floor undergoes a series of polishing and finishing techniques depending on the type of desired appearance. The first part of the grinding process involves revealing the aggregate

through the use of metal diamonds, which is the most important step. Then, resin diamonds are used. Once a sufficient amount of stone is revealed, the concrete is sanded to a fine polish using different grades of sanding stones. (1). “Concrete floor finishes have come a long way in recent years with the development of new techniques and treatments. Modern finishes include grinding to expose the aggregates, colours, stains and the use of special aggregates to achieve ‘rock’ or ‘marble’ appearances.” (2)



pictures: (1, 5 and 6)

Pros:

- “Polished concrete can cost less than a wood floor or a good carpet.” (1)
- Polishing concrete produces an extremely dense, abrasion resistant surface that will not delaminate. (1)
- “Concrete polishing prices will range from $3-7 per s.f. for a 3,000 grit finish based on size of the project and the number of obstacles. A 3,000 grit finish includes the use of an impregnating sealer that reacts with the concrete and fills the surface voids. The installation costs for polished concrete is half to one third the cost of topical sealers and coatings.” (3)
- Polished floors are more slip resistant than a standard tile floor, and a concrete floor that is polished to 3000 grit is less slippery than a sealed concrete floor. (3)
- Most topical sealers or coating contains higher VOC levels than impregnators used in the polishing process. Polished concrete is USDA approved, which has made it suitable for food processing plants (which require low VOC sealers). (3)
- The number one cause of failure of coatings is hydrostatic pressure. Hydrostatic pressure will build up under the coating and pop it off. Polished concrete can breathe, allowing moisture vapor to escape while not allowing salts or efflorescence to form. (3)
- “In terms of energy efficiency, concrete slabs are cool during the summer, and with the addition of in-floor heating running from off-peak power, provide a cost-efficient and highly effective heating system.” (2)
- Concrete floors don’t “harbor dust and mites to the extent of more traditional floorings.” (2)
- Since concrete is generally locally available, there are reduced transportation costs. This makes concrete a very sustainable building material. (4)

- Additionally, concrete can make use if recycled materials such as industrial by-products like slag or fly ash, from the production of steel and electricity respectively. (4)
- Concrete itself is also 100% recyclable. (4)
- Polished concrete can reduce lighting costs because of its high reflectance. (4)
- The only maintenance a polished floor will need is the removal of abrasives such as sand. Depending on the use of the floor, cleaning with a light detergent may also be needed. The service life of polished concrete cannot be determined as of yet since it is a fairly new process. But some existing polished concrete jobs that see heavy forklift traffic are over 5 years old and performing well with minimal maintenance." (3)

Cons:

- "The degree of shine involved plays a role in how much maintenance is required. Concrete can be polished to resemble a lustrous mirror finish, or it can be polished to a gleaming satin sheen or matte finish." (1)
- "The polished surface may lose some of its shine over time in areas of heavy forklift and foot traffic, but it can be brought back with minimal aggravation and cost. (1)
- "The number of polished concrete specialists across the country is limited... [because of] the cost of the equipment involved." (1)

Sources:

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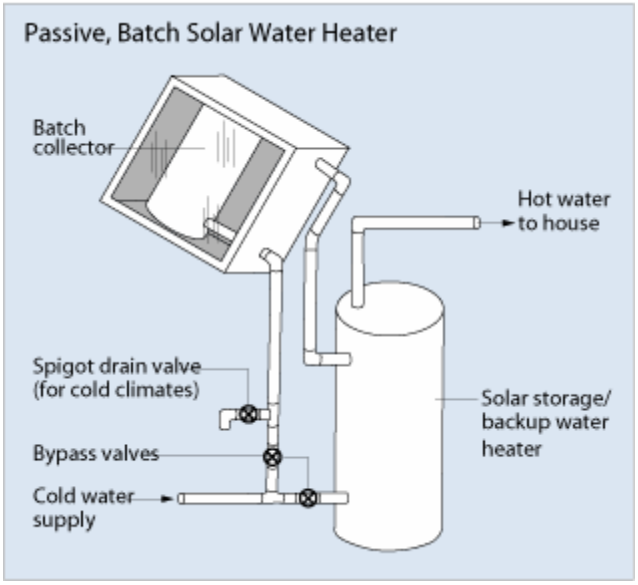
Solar Water Heaters:

Integral collector-storage passive systems:

What it is:

Also known as ICS or *batch* systems, they feature one or more black tanks or tubes in an insulated, glazed box. Cold water first passes through the solar collector, which preheats the water. The water then continues on to the conventional backup water heater, providing a reliable source of hot water. Unlike an active system, a passive system does not have any circulating pumps or controls. (1) The integral collector/storage is the simplest and historically oldest type of solar water heating system. (2)



picture: (1)

Pros:

- Solar water heating systems typically reduce water heating costs by 50% to 80% over minimum efficiency electric resistance or gas-fired water heaters.(3)
- In warm and sunny climates like Hawaii, a Solar Water Heating unit can meet 100 percent of a household's hot water needs. (4)
- Passive water heating systems tend to cost less than active ones. (1)
- A passive solar heating design for making domestic hot water or warming a home requires little or no electricity to operate. (2)
- Passive systems can be more reliable and may last longer than active systems. (1)
- Regular maintenance on simple systems can be as infrequent as every 3–5 years, preferably by a solar contractor. (1)
- The tank on this type of system usually resists freezing because of the tank's large thermal mass. (2)
- A new integral/storage system will cost about $2,500 parts and labor to install. After 7.3 years, the system cost will equal the cost of electricity to heat the same water during that time. The payback time is 4.8 years for the avoided cost of using electricity. (2)
- As of June 2005, Florida residents are exempt from paying sales and use tax on "solar energy systems" which includes those used for water heating. The exemption covers all the components of the system. (5)

Cons:

- Passive systems cost about $1,000 to $2,000 installed. (6)
- Solar water heating systems almost always require a backup system for cloudy days and times of increased demand. Since an integral-collector storage system already stores hot water in addition to collecting solar heat, however, it

may be packaged with a demand (tankless or instantaneous) water heater (which provides water from the only as needed) for backup. (1 and 7)
- The exterior pipes are vulnerable to freezing, which makes these systems unsuitable for areas that are prone to freezing temperatures. (1)
- Passive water heating systems may not be as efficient as active systems. (1)
- As with any solar collector, placement and upkeep is essential to make sure that the collector is exposed to the maximum possible amount of sun, and that debris and dust aren't hampering the collector's performance. (8)
- The water often doesn't reach a very high temperature because the glass-to-mass ratio is small in breadbox-type system. (2)
- Heat losses from the collector are high at night, so optimal use is during the afternoons and evenings. (2)
- The collector/tank combination can be heavy. Filled, it may reach 650 pounds, and tax an unreinforced roof. (2)
- To make the solar water heater as efficient as possible it will be necessary to have low flow and water efficient fixtures in the first place. This will help reduce the size and cost of the water heater. (9)

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9. http://www.indiasolar.com/swhinfo.htm

Insulation:

Note: One advantage to insulation in general is the enormous potential it has to increase the heating and cooling efficiency of a house. According to the Department of Energy, "inadequate insulation and air leakage are leading causes of energy waste in most homes." (http://www.ornl.gov/sci/roofs+walls/insulation/ins_01.html) It is important though, to remember that any type of insulation will not be effective if care is not taken to properly seal the structure for air leaks and properly install the insulation to prevent exposure to soil or degradation of R-value. (http://www.ornl.gov/sci/roofs+walls/insulation/ins_07.html)

Make sure R-values (per inch) are listed for all types

Cotton:

What it is:

Cotton insulation is made from denim scraps and comes in batts like fiberglass. “Carding machines pull the scraps apart to free individual fibers, similar to the fraying that occurs on the hems of well-worn jeans. The manufacturer saturates the fibers with a fireproofing solution, dries them, mixes in polyolefin fibers and heats the mixture. Polyolefin, probably the least-known of the major types of synthetic fiber, melts from the heat and acts as the "glue" that holds the batts together.”(1) “Proprietary microscopic olefin fibers are added to the cotton fiber matrix to give the insulation three-dimensional loft and rebound after compression. Borates are added for resistance to pests and combustion.” (2) Cotton insulation has an R-value of R-3.4 per inch. (3)

pictures: (2, 4, and 7)

Pros:

- Cotton insulation generally consists of around 85% post-industrial recycled cotton fiber and about 15% plastic fiber and borate treatments (to prevent pests and combustion). (2)
- The cotton batts are easy to handle because one doesn’t need to worry about skin coverage or respiratory protection (unlike handling fiberglass), and the batts can be simply torn by hand for custom sizes. (2)
- The insulation does not contain any formaldehyde, irritants, or VOC’s. (4)
- The batts are oversized (width-wise) to allow for a tight friction-fit and full cavity fill. This significantly reduces the opportunity for air-convection and infiltration. (5)
- Cotton insulation is permeable thus it “breathes” and will allow for “vapor-diffusion” and “dryout” if water/moisture saturation occurs. (5)
- The micro-fibers in the insulation minimize “settling” of the insulation and microscopic air pockets maintain the thermal consistency of the building envelope, even in extreme temperature ranges. (5)
- Cotton batts are 100% recyclable at the end of their useful life. (6)
- Cotton insulation has a low embodied energy to produce while fiberglass has a relatively high EE to produce (EE is the measure of the energy required to produce a finished product). (5)

Cons:

- Cotton insulation can be 15-20% more costly than fiberglass. (2)
- Cotton must be protected from water leakage. If the borate treatment fails (washed out by a leak, for example), the material loses its fire and mold resistance (as would cellulose). (6)

Sources:

1. http://www.environmentalhomecenter.com/shop.mv?CatCode=PRODUCT&ProdCode=COTTON_INSULATION
2. http://www.buildinggreen.com/auth/article.cfm?fileName=091106a.xml
3. http://www.eere.energy.gov/consumer/your_home/insulation_airsealing/index.cfm/mytopic=11560
4. http://www.bondedlogic.com/ultratouchfaq.htm
5. www.wconline.com/CDA/ArticleInformation/features/BNP__Features__Item/0,3299,128925,00.html - 23k
6. http://www.toolbase.org/techinv/techDetails.aspx?technologyID=227
7. http://www.phoenixorganics.com/4054/ultratouch.jpg

Cellulose:

What it is:

Cellulose insulation is made from recycled newspaper and (sometimes) small amounts of cardboard shredded into a fluffy mass, cellulose is sprayed slightly damp, or blown dry, into wall and ceiling cavities, as well as attics. Loose-fill cellulose insulation is typically treated with boric acid to thwart mold, increase fire resistance and repel hungry insects. Some manufacturers add a moisture-activated acrylic binder that causes the cellulose particles to adhere better, which reduces settling. (1) Cellulose insulation has an R-value of R-3.6 to R-3.8 per inch. (2)

pictures: (1, 3 and 10)

Pros:

- Cellulose insulation often consists of about 85% recycled content with a minimum of 80% recovered, post-consumer paper fiber. The remaining 15% of the material is generally fire retardant chemicals and stabilizing additives. (3)

- Cellulose insulation is generally less expensive (up to 25 percent) than fiberglass batts, and provides more insulation per inch than low-density fiberglass (R-2.2 per inch). (1)
- "Cellulose also poses fewer health risks to installers and home owners. Although blowing or spraying cellulose into wall and ceiling cavities produces dust, there are no fibers found in cellulose that are potentially cancer-causing. A simple face mask or respirator protects installers." (1)
- "If cellulose is applied with added water and an adhesive binder, settling and dust are greatly reduced relative to the more traditional dry application. Thermal performance does not suffer with this application." (4)
- "In 1990, the University of Colorado-Denver compared cellulose and fiberglass batt insulation in identical structures during the winter heating season. They found that the house insulated with cellulose insulation was 38% tighter and required 26% less energy." (4)
- "Cellulose and rock wool are more resistant to airflow than fiberglass because they are denser. They may also be more effective at reducing air leakage and associated heat loss, because their higher densities cause them to settle and seal more around rafters and in corners." (5)
- The Cellulose Industry Standards Enforcement Program (CISEP) in November 1991 hired ORNL (University of Illinois and Oak Ridge National Laboratory) to run a series of tests on cellulose. The results showed no decline in R-value using cellulose insulation. (4)
- "Fiberglass batt insulation cannot be fitted tightly around wall inclusions, such as pipes, wires and electrical boxes. Cutting a batt to fit, and pressing it around plumbing and electrical details creates gaps and depressions that seriously degrade the thermal performance of the wall. Dense-packed or sprayed cellulose insulation fits around everything in the wall, creating a tight, uncompromised thermal barrier." (6)

Cons:

- Cellulose insulation should not be installed in areas where temperatures exceed 194° F, or in areas of excessive or continuous moisture. (4)
- "Dry-blown cellulose may settle and sag, creating air spaces. It also can absorb moisture, decreasing its R-value over time. If it remains damp for prolonged periods, cellulose can mold and rot." (1)
- "Approximately 20% of the finished cellulose product is comprised of fire retardant chemicals (80% newspaper / 20% fire retardant chemicals). These fire retardant chemicals may not be applied consistently and may deteriorate over time. Smoldering and re-kindling of fires have been reported with this product." (7)
- "Although the cost of fiberglass compared with cellulose materials is about the same, the labor to install the cellulose is more. On a small residential remodel with open stud cavities, the installed cost of cellulose can be as much as 50% more than fiberglass batts." (8)
- Studies of wet insulation drying rates showed that vapor retarders were being installed "within two days of the sprayed cellulose application," but that the

insulation itself was not drying by this time. In some instances the insulation was not completely dry after one year. Wet cellulose insulation is prone to mold and will not insulate properly. (9)

Sources:

1. http://www.motherearthnews.com/top_articles/2002_December_January/All_About_Insulation
2. http://www.eere.energy.gov/consumer/your_home/insulation_airsealing/index.cfm/mytopic=11660
3. http://www.cocooninsulation.com/RecycledContent.asp?Type=H
4. http://www.cocooninsulation.com/RValue.asp?Type=H
5. http://doityourself.com/insulate/loosefillinsulations.htm
6. http://www.cellulose.org/cellulose.html
7. http://www.jm.com/insulation/faqs/1007.htm
8. http://www.greenguide.com/energynotes/
9. http://www.naima.org/pages/resources/library/html/BI460.HTML
10. http://www.comfizone.co.za/Products.htm

Formaldehyde-free fiberglass:

What it is:

Fiber glass is composed principally of natural ingredients such as sand and recycled glass from sources like old windows and used beverage bottles. The ingredients are melted and spun to create thin glass strands that form fiber glass insulation. Fiber glass is the most widely used home thermal insulator. (1) One type of formaldehyde-free insulation uses an acrylic binder that doesn't contain the formaldehyde associated with normal fiberglass insulation. (2) Another available formaldehyde-free option is one that contains two types of glass fiber that expand and contract at different temperatures. This causes the fibers to curl and twist, which helps them bind together without chemicals. (3)

Formaldehyde has been classified as a known carcinogen by the International Agency for Research on Cancer (IARC), and an indoor pollutant by the EPA. (1) Fiberglass batts have an R-value of R-3.2 to R-3.3 per inch when fully expanded. (4)

pictures: (2)

Pros:

- Formaldehyde-free insulation is naturally mold and mildew resistant. (2)

- The absence of a formaldehyde binder does not affect the thermal properties of fiberglass. (http://www.jm.com/insulation/building_insulation/4478.htm#)
- Fiberglass doesn't shrink, won't burn and is unappealing to insects. (http://www.motherearthnews.com/top_articles/2002_December_January/All_About_Insulation)
- The acrylic binder has a low toxicity and performs the same function as a phenol-formaldehyde binder in ordinary fiber glass products: it binds fiber glass together while providing the strength, durability and resiliency required by the insulation industry. http://www.jm.com/insulation/building_insulation/4478.htm#)
- The acrylic binder is stable at the high temperatures and humidity found in attics in summer. In contrast, ordinary formaldehyde-bonded insulation could off-gas formaldehyde at higher rates when temperature and humidity are elevated. This is especially true if the formaldehyde binder is extended with urea because urea-formaldehyde products tend to release more formaldehyde. (1)
- Fiberglass generally contains a percentage of recycled glass content, ranging from 25 to as much 40%. (5 and 3)

Cons:

- Although fiberglass insulation is the industry norm, fiberglass has been listed as a possible carcinogen by the International Agency for Research on Cancer (IARC). (6)
- It is necessary to take he same precautions are against irritation as for ordinary fiber glass, viz., use gloves, eye protection, and a NIOSH-approved N-90 respirator. The installer should also continue to wear loose-fitting clothes (long sleeve shirt and long pants), which should be washed separately. (1)
- Fiberglass blankets do not seal wall and ceiling cavities very tightly, and unless installers use encapsulated batts, a vapor barrier is required to protect the insulation from moisture. (3)
- Formaldehyde-free fiberglass insulation may cost more than conventional fiberglass, but will likely fall around the same price as the “green” options listed above since fiberglass is generally the cheapest insulating option. (1 and 7)

Sources:

1. http://www.jm.com/insulation/building_insulation/4478.htm#
2. http://www.jm.com/insulation/building_insulation/4465.htm
3. http://www.motherearthnews.com/top_articles/2002_December_January/All_About_Insulation
4. http://www.askthebuilder.com/B54_Insulation_-_Fiberglass_and_Cellulose.shtml
5. http://www.betterinsulation.com/JohnMansville.htm
6. http://www.idph.state.il.us/envhealth/factsheets/fiberglass.htm
7. http://www.ci.austin.tx.us/greenbuilder/srcbk_4-7.htm