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Greywater Systems- Benefits, Drawbacks and Uses of greywater

Using grey water is a sustainable concept that can be implemented many different ways. Greywater is generally defined as household wastewater (as from a sink or bath) that does not contain serious contaminants (as from toilets or diapers). Greywater is regulated by state and local governments and each of these entities have their own, more specific definition. For example, the state of California, in the Uniform Plumbing code defines gray water as:

> *Greywater is untreated waste water which has not come into contact with toilet waste. Greywater includes waste water from bathtubs, showers, bathroom wash basins, clothes washing machines, and laundry tubs, or an equivalent discharge as approved by the Administrative Authority. It does not include waste water from kitchen sinks, photo lab sinks, dishwashers, or laundry water from soiled diapers.*
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> *Surfacing of greywater means the ponding, running off, or other release of greywater from the land surface.*

Greywater is used for irrigation or other uses such as filling toilet bowls. In 1997, in California grey water was approved for use in commercial, industrial, and multi-family projects. Prior to that, it was only available in single family homes. A permit is required to install greywater systems in California, and they must be contained to their own property. All California greywater systems must adhere to the California Plumbing Code.

The use of greywater results in lower fresh water use, less strain on failing septic tanks or treatment plants, less energy and chemical use, reclamation of otherwise wasted nutrients. All of these benefits equal a savings in energy and the natural resource that is water.

Greywater is an important sustainable concept for several reasons. First on average, in a household each person will use 80-100 gallons of water per day. The largest contributor to this use is flushing the toilet.

26%	toilet flushing
20%	showers and baths
15%	kitchen and bathroom faucets
3%	cleaning and washing dishes
23%	laundry room
13%	leaks

Kitchen and bathroom sinks combined only use 15% of the water that comes into a home. This is significant in that 100% of the water that comes into the home has been treated and made potable for drinking. If some of the water for uses other than drinking could be greywater, the energy and resources consumed in the water treatment process could be saved.

Greywater systems have been most popular in single family non-urban homes. This is because those homes had an easier time meeting criteria such as that which requires the greywater to be contained to the property. Urban homes or multifamily homes have traditionally had less landscape to irrigate so there have also been less use for greywater.

Greywater systems can work in several different ways. The two broad categories for greywater use include indoor reuse and outdoor reuse. Outdoor greywater is usually filtered and then used for watering landscape. They types of outdoor greywater systems include evapotranspiration systems, which combine the process of evaporation and transpiration to utilize and dispose of wastewater. A typical evapotranspiration system consists of a septic tank for pre-treatment (removal of solids) followed by distribution into a shallow sand bed covered with vegetation. The greywater is distributed through perforated pipes. Once in the sand, greywater is taken into the plant root system. Underneath the bed is either a plastic lining or very impermeable soil which prevents the grey water from seeping into the ground. Another type of system that provides greywater for irrigation use is the Shallow Trench. Greywater is piped from the house into shallow trenches that are properly spaced and close enough to the surface to feed plant roots.

Indoor greywater use mainly recycles water for flushing toilets. Earthships, designed primarily in the Southwest by Michael Reynolds illustrate extensive grey and black water systems. Earthships claim to use water four times. First they catch water off of the roof, which is made of a potable material. After catching the water the second use for the water is washing or bathing. From there it drains into interior botanical cells, which are indoor planters. The plants use and clean the water, which is then used for flushing toilets. The final use of the water is the black water system that contains and treats the water in exterior botanical cells.

Earthships are holistically designed, and this system is less applicable to pre-existing buildings built to today's building and plumbing standards. There are systems available that work with existing structures to capture greywater, but not as extensively as Earthships. The AQUS system from Watersaver Technologies is designed to be able to be retrofitted into any bathroom. The focus of this technology is to save the waste water from the sink, and use it to flush the toilet. To do this, a reservoir is installed under the sink and attached to the toilet. The toilet can then draw first, on the resources in the reservoir while still be connected to the typical water source for the house. Since the toilet is the number one consumer of water in households, this system can save up to 5,000 gallons per year. This system is especially applicable in urban areas, or in buildings where irrigation is not possible or necessary.

These systems become most effective when they are both environmentally and economically sustainable. The Aqus system is highly replicable by design, and intended to be easy to install in any building or home. More extensive systems like the Earthships can be replicated as well, however those systems will tend to be a major design feature and will need to be budgeted for and included in the design of a new building early on. Economically, the cost of water is not always metered, so some customers will not see the economic returns of investing is these systems. As jurisdictions realize the value of

water and the value of treated water, many are beginning the metering process to pass this value onto the consumers.
Industrial systems of greywater use can save a tremendous amount of water since most industrial systems requiring water do not require potable water. The most notable example of industrial greywater use is the City of Austin's approach. The Austin water utility recently passed a municipal bond issue that has allowed the water utility to install a reclaimed water pumping system parallel to the existing potable water system. A series of blue pipes interconnect throughout the city providing industries, commercial irrigation works and other nonpotable water users with cheaper reclaimed water. The system is designed to recycle upward of 40 million gal (approximately 150 million liters) per day.

The biggest challenges seem to be the legal issues concerning greywater. Laws regarding greywater are often a "grey issue" and liability concerns seem to slow this technology down. There seem to be very few case studies of successful greywater systems other than in single family homes. These systems become most effective when they are both environmentally and economically sustainable. The Aqus system is highly replicable by design, and intended to be easy to install in any building or home. More extensive systems like the Earthships can be replicated as well, however those systems will tend to be a major design feature and will need to be budgeted for and included in the design of a new building early on. Economically, the cost of water is not always metered, so some customers will not see the economic returns of investing is these systems. As jurisdictions realize the value of water and the value of treated water, many are beginning the metering process to pass this value onto the consumers. The city of Austin installed the system described earlier with confidence that it will pay for itself.