SILO

Innovation Narrative

Missouri University of Science and Technology

INTRO

A Smart Innovative Living Oasis, SILO, introduces systems both on and off the market to create an innovative approach to building, not just a solar home but also a smart home. The range of technologies goes from systems relating to comfort, energy utilization, and home automation. SILO incorporates leading technologies in order to showcase the potential of economical and sustainable living.

The 21st century has introduced a new age of homes with various technology. The team developed design solutions through the schematic design phase by researching the best technology to include in SILO to create an innovative energy efficient home.

SILO is designed for a couple in their late 40's and early 50's looking to find a smaller home to start living more sustainably after their kids have left to forge their own futures. With this in mind SILO has chosen products and systems that are user friendly and intuitive for the homeowner.

Solar Panels, Batteries, and Microinverters

Often times innovation in energy comes down to efficiency. SILO utilizes a monocrystalline panel with a maximum power output of 355W and an overall module efficiency of 20.6%. This panel has a guaranteed 95% average performance efficiency in the first 5 years and 87% after 25 years. The panel was created to be more appealing by removing the electrodes in the front. This creates a seamless design without suffering in performance.

Each panel is fitted with a top of the line microinverter, not just for efficiency, but also for the overall design concept. Installing the inverters are as easy as connecting the cables into the circuit box. These systems are the first of their kind with minimal installation.

The batteries are equally competitive. It is the first residential battery to be UL 9540 certified which ensures the homeowner that the batteries are made with safety in mind. The lithium iron phosphate battery is considered an "AC battery" since the battery contains its own inverter that will take AC energy and transform it into DC for storage. When the power is needed then the power can be reverted back to AC to be used in the house with a round trip efficiency of 96%. This is 6% more efficient than the nearest competitor. The storage system is built with modularity in mind, which means that the battery comes in a small form that can be easily added to. On top of that, installation is as simple as mounting the bracket, connecting the AC wiring, and securing the battery onto the mounting bracket. SILO is, in fact, the first house to utilize the battery in the world.

Both the batteries and the microinverters are built to better communicate with a device that manages and tracks energy generation and consumption.

Overall the solar system fits well with the target location. The panels were sized based on appliance usage ratings, average sun hours of Denver, a tilt angle optimal for efficiency, and yearly tracked data from Missouri S&T's solar villages.

The lighting system within the home was designed by a lighting design class on campus. The students were tasked with creating a system that would meet the requirements for competition in regards to lighting levels. While completing these calculations, students were asked to design a system that uses daylighting and uses the least amount of energy possible through light fixture choices. The results were designs using LED lights and dimmable switches to control the lighting.

Home Automation System

The age of smart homes is here and SILO does not fall behind on smart home technology. SILO's home automation system is spearheaded by the Amazon

Echo which can control many different systems ranging from the lights, HVAC, and speakers. The Amazon Echo, fully functions as a home automation hub within the house and interacts with different devices.

SILO has two integral parts to its home automation system: the physical control hub and the data center. The physical control hub contains the Amazon Echo, Nest thermostat, Lutron switches, and the speaker system whereas the data center contains a sensor network which collects and sends data. The data obtained tracks the house's overall usage which in turn allows the user to make changes to the way they live to further save energy.

Most of the individual systems connected to the Amazon Echo's hub works like any other appliance with the added benefit of being connected to the internet. The Amazon Echo acts as a web that ties all of these systems together; the Echo app allows the user to just add these devices into its "known devices" section. The application also gives many helpful tips to aid the user in connecting these devices together. The system itself is user friendly which means that anyone can set up and use the system in no time.

Green Wall & Greywater

Three of SILO's striking state of the art design features are the green wall, greywater system and water wall; all of which provide an aesthetic and practical purpose.

Two movable green walls hold a multitude of plants and are designed to be movable to serve a thermal barrier. Water is added to the basin of the green walls, pumped to the top of the panels, allowed to flow back down to the basin, and circulated through the system again. Once the water has reached the basin, it can be pumped back through and then finally removed when the water is no longer fit for reuse.

A common method of growing vertical gardens is by implementing a full-scale hydroponics system. The green walls used in SILO are unique in this aspect because the variety of plants grow in soil instead of in a water-based system. Planting in soil is advantageous to SILO because it allows for less water use by the green walls in the overall lifecycle of the walls. Using soil for the transportation of the house also conserves more water than maintaining a hydroponics system during transportation. Both green walls are mounted on top of a basin that collects greywater as it circles through. The walls are designed to be movable and can be placed anywhere the homeowner sees fit. For example, when the winter months begin to approach, the vertical gardens can be moved indoors, allowing for plant life to thrive longer and contribute to the home's indoor beauty.

One of the most ecological student-designed systems in SILO combines various off-the-shelf products to filter greywater for reuse. Shown in Figure 1, the system is comprised of a spin, activated charcoal, and ultraviolet filters that take water from the bathroom sink, shower, and washer. Sediment filters remove particulates that may escape through the waste stream. Carbon block filters are used to remove chlorine and other unhealthy chemicals. UV filters then destroy harmful pathogens that may cause disease in plants. This system works to provide water for the movable green walls and other non-edible plants the homeowner may have.
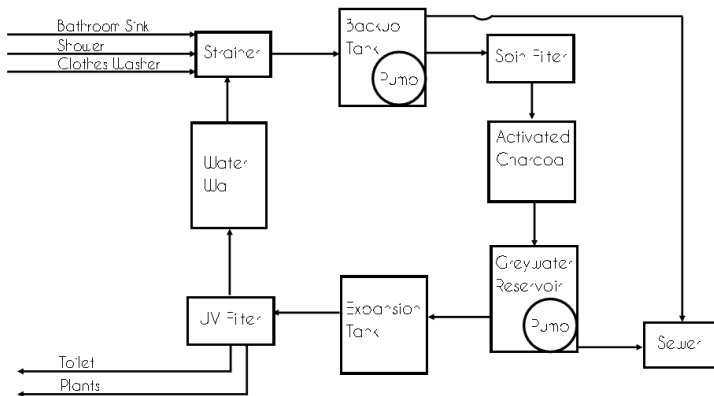
Figure 1: Greywater Oneline

Typically, greywater can only be stored for twenty-four hours because the stagnant water would start to grow bacteria. To overcome this issue, S&T students designed a water wall which aerates, prevents stagnation, and limits anaerobic bacteria growth. This system extends the time the water is usable, which has been a hindrance in many greywater systems. The wall itself stands five feet tall and is composed of a large pane of glass surrounded by a wood casing with an enclosed pump and reservoir. The greywater system pumps water into the wall and through a piece of tubing running above the glass. Holes are cut in the tube, creating a constant flow of greywater down the glass. Furthermore, this running water allows the homeowner to fully experience the peaceful sounds emitted by the water wall while aerating the greywater for future use.

Conclusion

The solar technologies, home automation system, green walls, and greywater system exemplify the "Innovative" in SILO. By using these systems in a cohesive manner, the homeowner is able to live in comfort while still living sustainably