Ultra Low Energy: The Suwannee River Administration Building *Clinch County, Georgia*

You may have heard of **Ultra Low Energy**† buildings — energy self-sufficient, solar-powered structures; buildings without utility bills, or well on their way to that end. But you look at your own utility bills and the cost of solar energy systems, and you wonder just how this can work. There are four essential ingredients to making an **Ultra Low Energy** building work:

- The **Ultra Low Energy** building is primarily powered by **photovoltaic and solar hot water systems**, both likely mounted on the roof.
- The **Ultra Low Energy** building is so efficient—as much as **90% more efficient than the average structure**—that demand for power can be met, or nearly met, with readily available and reasonably sized solar power systems.
- The **Ultra Low Energy** building always needs a back-up—some energy from the grid in the case of the Administration Building—to deal with times when the weather and the big energy demands (space heating or cooling, water heating, and refrigeration) combine and conspire.
- The fourth ingredient is **you**. To tread this lightly on the land requires that you are a part of the system, tuning your energy use to complement rather than stress the Ultra Low Energy building. This does not mean thermal privation or hand-cranking your radio—it means learning a lot about how your home or office works, occasionally outwitting the big energy demands, and maybe expanding your comfort zone just a bit.

So, the trick is to stock your roof with panels; your home or office with the most efficient and integrated exterior envelope, HVAC system, water heater, appliances, and lighting available; and your family or co-workers with zero energy savvy. You will have to do **all three**. Here is what it takes to do each.

Ultra Low Energy Building Performance Although most people associate the term zero energy with solar panels, the starting point must always be the efficiency of the structure and its heating/ventilation/air conditioning (HVAC) system. The way to really fine-tune the energy performance of a building is to treat the structure and the HVAC system as integrated systems, matching their features and individual contributions to the whole.

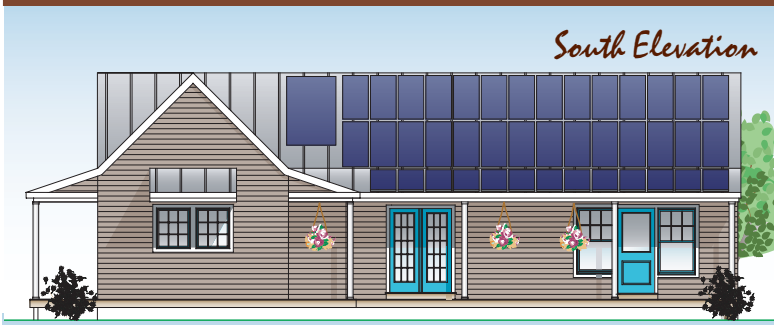
1. The exterior walls, floors, roof, and windows – These are all of the components of the exterior envelope. How much they resist heat conduction (their R-value), how airtight they are, and how they are oriented with respect to the sun and prevailing winds (particularly windows) all are major determinants of energy performance. The building design, the materials selected, and the quality of installation must work together to achieve maximum efficiency. A key component of the Suwannee River Administration Building is the **Structural Insulated Panels**—or SIPs—used for the roof and walls. SIPs are typically made using expanded polystyrene (EPS), or polyisocyanurate rigid foam insulation sandwiched between two structural skins of oriented strand board

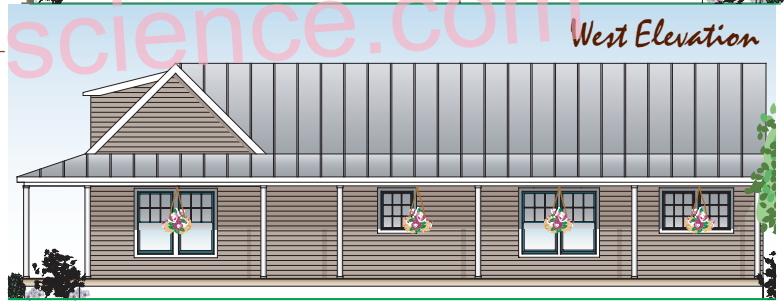
Owner: Georgia Dept. of Natural Resources Parks, Recreation and Historic Sites Division

1,700 sq. ft. building

Key Features

- Photovoltaic system
- Solar hot water heating
- Design for passive cooling and lighting
- Ducts in conditioned space
- Controlled ventilation
- High performance envelope, windows and an integrated HVAC system
- Advanced framing with structural insulated panels (SIPs)
- Designed to promote natural ventilation/controlled mechanical ventilation for back-up





† **Ultra Low Energy** buildings are the next of kin to the more widely known Zero Energy buildings. We have scrupulously included all loads (heating, cooling, hot water, plug and appliance loads — both electrical and non-electrical) in our work on this building. As a result, we are not quite at the Zero Energy performance level. Perhaps a rather fine distinction, but an important one in the balance of optimism and realism.

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(OSB). The result is a building system that is very strong, predictable, energy- efficient and cost-effective. Their superior R-value and air tightness are essential to the high performance of the Administration Building.

The Suwannee River Administration Building is designed for **passive cooling and daylighting**. Key elements include:

- deep wrap-around porches and window awnings for maximum shading and lots of indirect daylighting;
- number and location of operable windows (for cross ventilation) and high ceilings (for stack effect ventilation);
- highly reflective white standing seam metal roof cladding.

These all work to reduce the need for mechanical cooling and electric lighting.

2. The HVAC system – Building a high-performance structure allows you to really fine tune or "right-size" your space heating and cooling unit, your fresh-air ventilation, and the ducts that deliver all three. Essential elements to the Administration Building include a variable-speed ECM air handler, a two-stage 13.25 SEER/ 8.95 HSPF heat pump unit, and a scheduled intermittent **outside air ventilation system** that also provides mixing of all interior air. Mechanical ventilation, you say? You can't build this tight and not purposefully introduce the outside air you need.
3. Water heating – After your HVAC system, water heating makes up the largest single energy demand in the building. Solar water heating (described below) is an **essential part of any zero energy strategy**, but you always need a back-up. While there are several options to consider—combo systems (combining water and space heating), heat pump water heaters, instantaneous systems—the Suwannee River Administration Building simply has the top-of-the-line electric tank water heater. Given the fact that solar hot water will be available much of the year in this climate, it was the most reasonable water heating solution.
4. Lighting and appliances – Once the energy performance of the structure, the HVAC, and water heating have been optimized, "**plug loads**" become the next target for significant energy improvements. It begins with the big boys—the refrigerator and lighting—and reaches down to the dishwasher, dryer, and household items such as the television and microwave. The higher performance of many of these items also reduces air conditioning needs in climates with any cooling period.

The Photovoltaic System To turn sunlight into usable electricity requires:

- panels - to collect the solar energy and convert it into direct current (DC) electricity.
- an inverter - to convert the DC into alternating current (AC), matching your building's conventional electrical system.
- a controller – to manage where

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Suwannee River Administration Building

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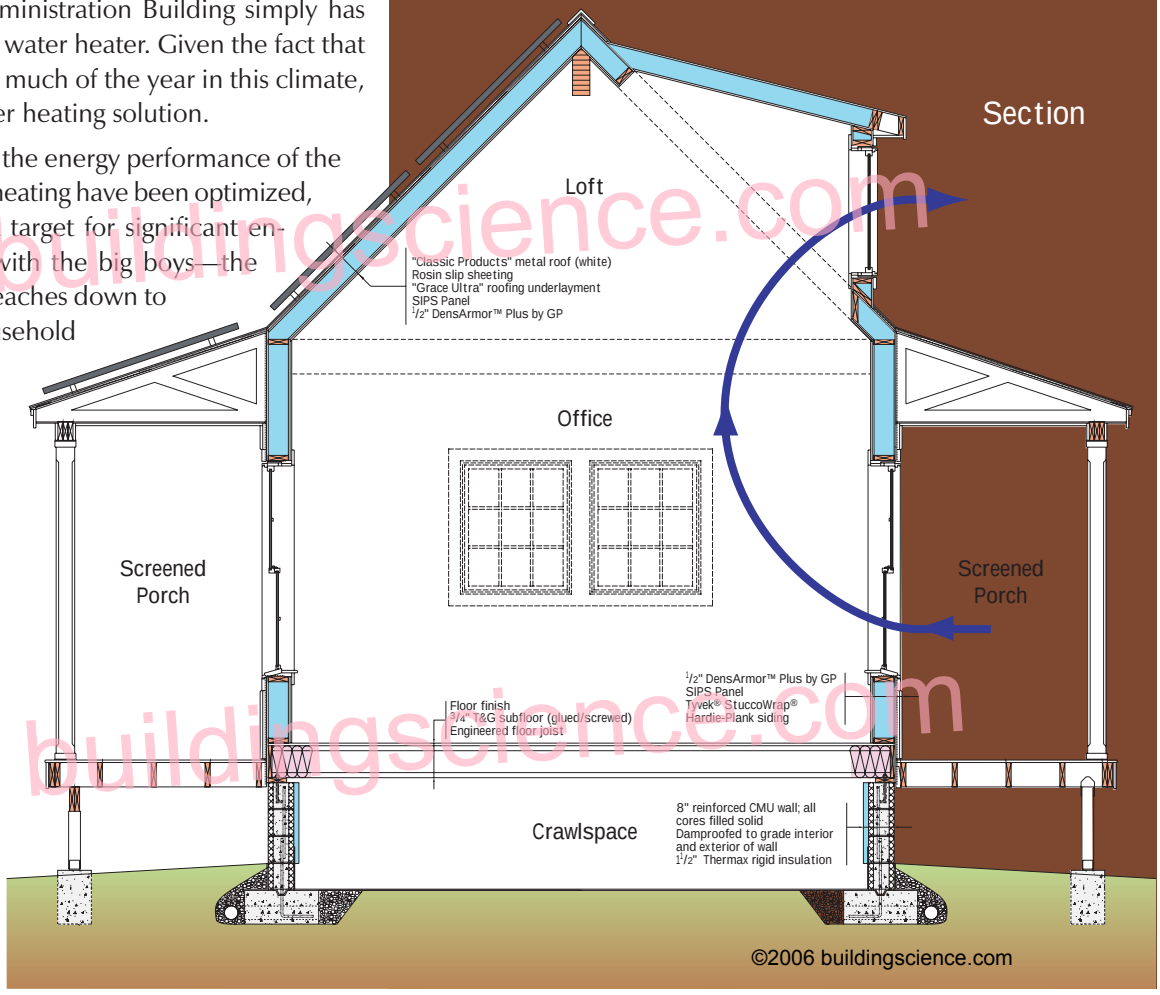
Lower heating bills translates to lower energy (fossil fuel) consumption and greenhouse gas emissions

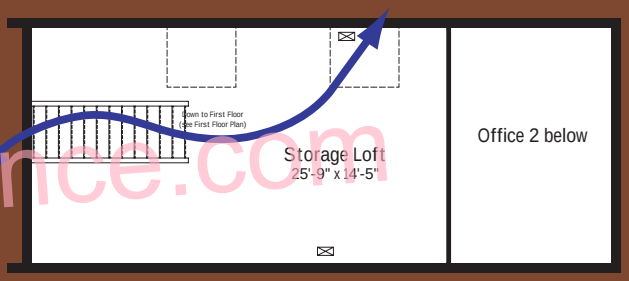
SIPs buildings, by their panelized nature, lend themselves to airtight construction



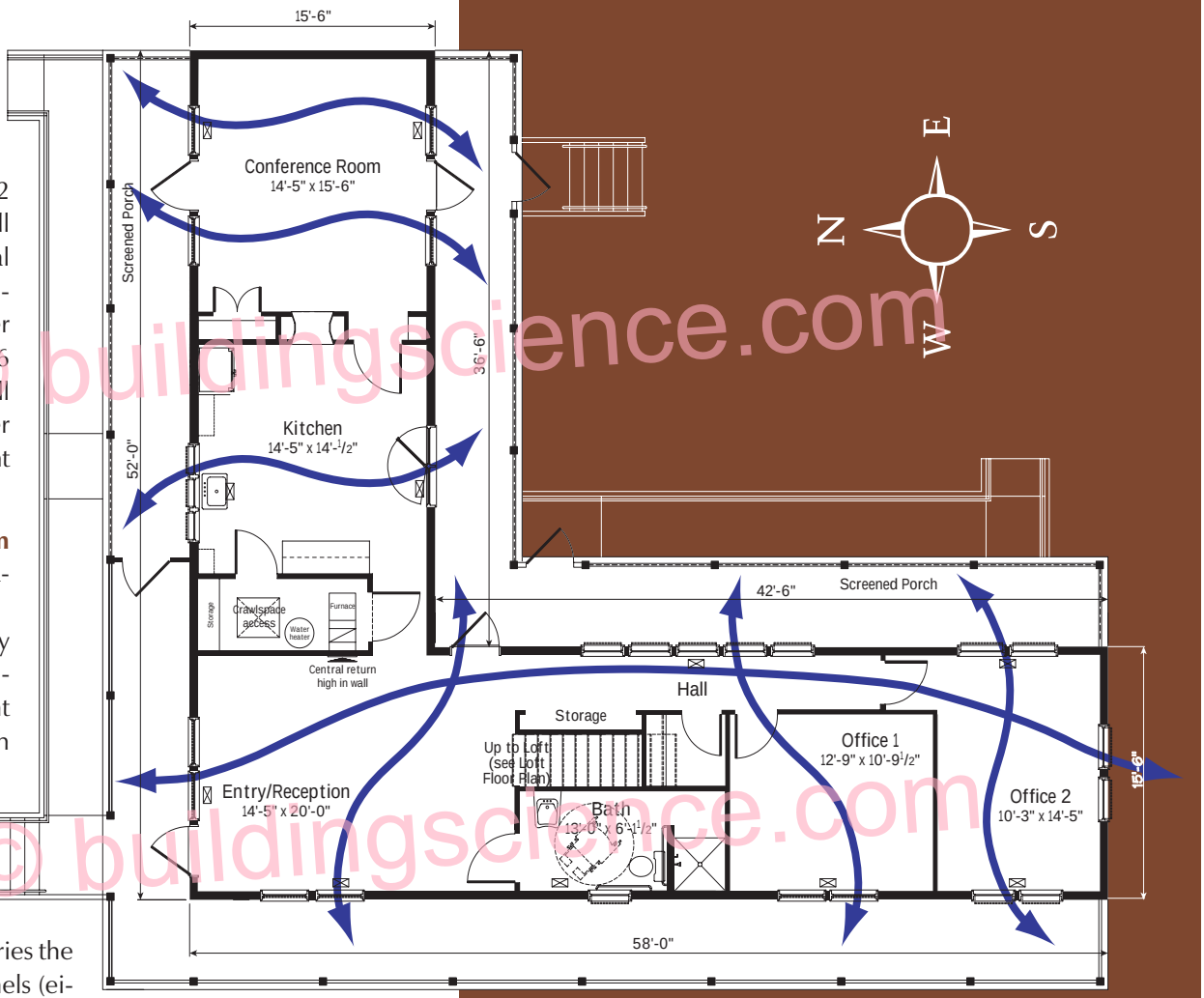
the solar and grid-supplied power go, to or from your home or office and the grid.

Over the past few years, each of these components has been rapidly evolving and improving so that today they are compatible, code-compliant, and cost-effective. Lots of work has been done to bring the efficiency of the panels up and their cost down, and to link the panels into system packages so that you don't have to build the system. And in many states (and maybe the whole country with residential energy efficiency legislation pending in Congress), rebates and tax incentives exist to subsidize solar equipment investment.

For the Suwannee River Administration Building of 1,700 square feet with a staff of three to four people, a 4.1-kilowatt system with 40 EC-102 panels will supply nearly all of the building's electrical needs. Like most PV systems, the Suwannee River PV system costs about $6 per watt. But the system will continue generating power with little to no replacement for many years.



Loft Floor Plan



First Floor Plan

The Solar Hot Water System

To turn sunlight into hot water requires:

1. roof panel(s) – essentially box "greenhouses" containing highly absorbent piping and faced with double-glazing that lets light in yet traps significant heat energy for the piping to capture.
2. transfer piping – this carries the liquid heated in the panels (either pure water in direct systems or a coolant/water mix in indirect systems) down to either a storage tank or the water heater tank (direct system) or to a heat exchanger (indirect system).

In the Suwannee River Administration Building, one 4' x 8' collector at peak efficiency (when the sun in a cloudless sky is shining directly over the panels) supplies most of the hot water for the office staff and visitors.

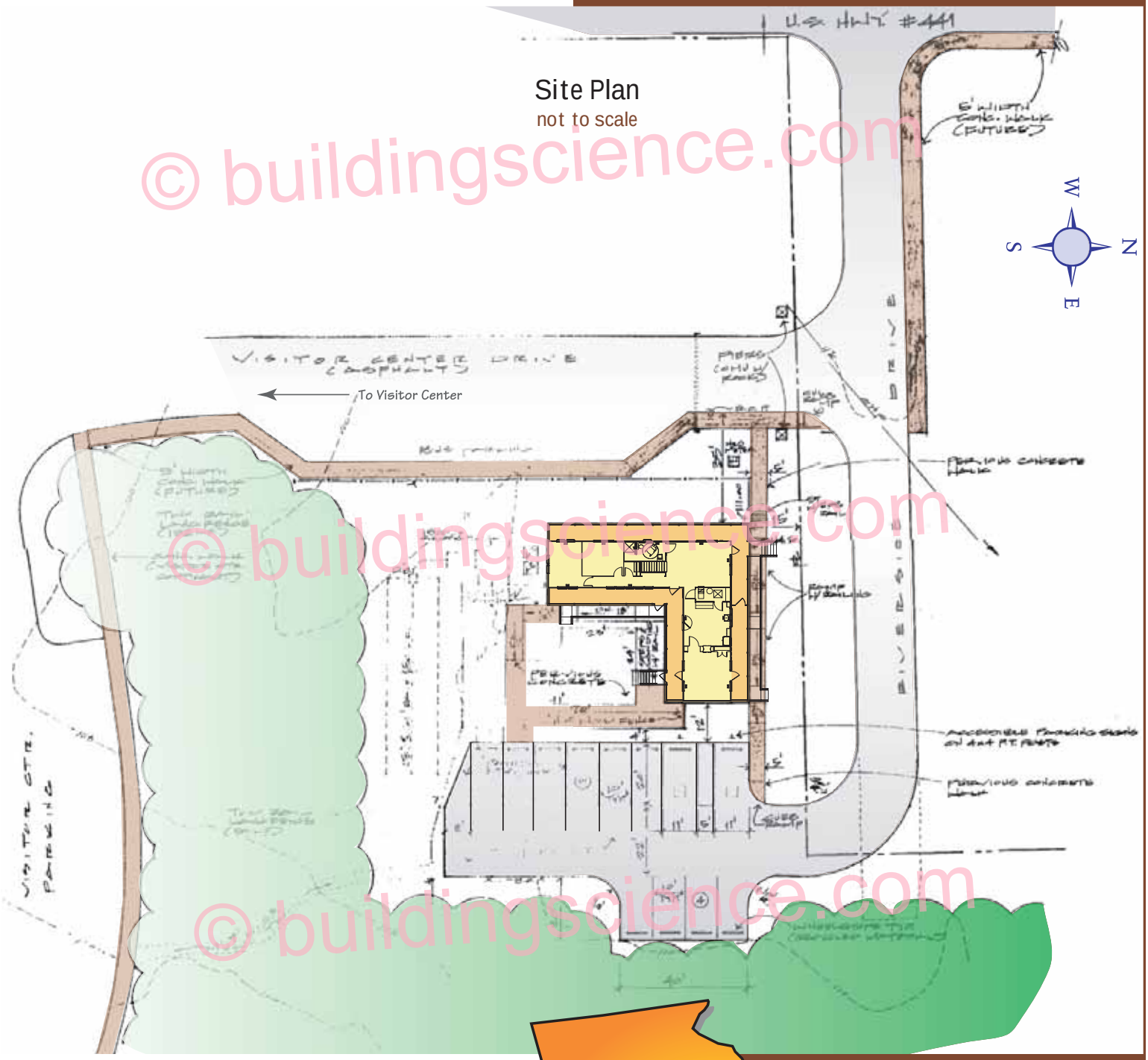
The Ultra Low Energy Building Owner You can't fine-tune the energy performance of a building like this without being a smart operator and maintainer. **You** will determine whether the term "grid back-up" is spelled with a lower or upper case "g." **You** will determine how often your meter runs forward (you pay them) or backward (they pay you) as part of **net metering**. Here are some of the "little" things that will help you optimize the performance of your building:

A Word on Durability

This building is engineered for optimal use of materials and durability. From the wrap-around porches to the standing-seam aluminum roof, this building has been designed and commissioned with components and systems for outstanding service life.

Site Plan

not to scale



- When temperatures and breezes permit, use your windows for passive cooling.
- Manage your hot water needs—showering, clothes and dishwashing—to coincide with peak solar performance.
- Treat all electrical use—ceiling fans, lighting, TV, computers—as task-oriented: on when used, off when not.
- Manage daily household activities for maximum heating and cooling benefit during extreme outdoor conditions—microwave use instead of stove top cooking and baking in the summer, or indoor activities in the winter.

Follow building component maintenance schedules religiously.