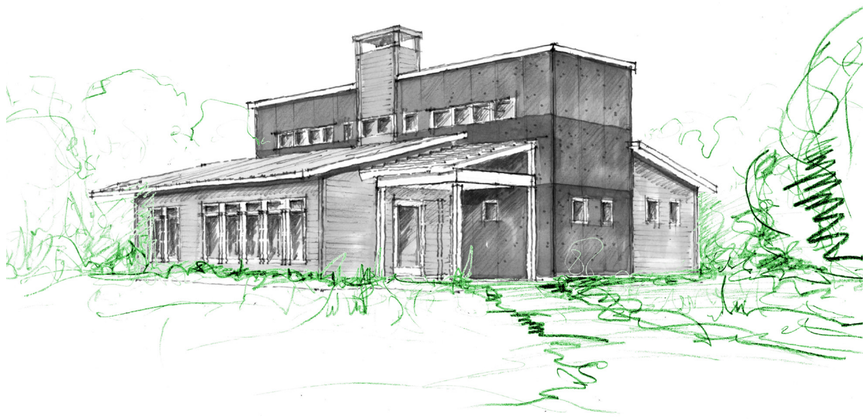


INTRODUCTION

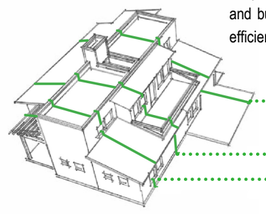
The Clemson Zero Energy House is a research program committed to designing and building an affordable low-energy house adaptable to the specific climatic concerns of the Southeast. The final product will be a showcase of contemporary architectural design, while still maintaining a familiar feel to appeal to the average homeowner. The house will demonstrate what can be achieved with forethought in architectural design and planning to achieve a low-energy home from natural materials at an affordable cost. The design for the house does not include a particular site, making the house ideal for adapting to any site around Southeastern States, and will be active-ready, meaning the homeowner can decide to add active energy-gaining technologies (i.e. photovoltaics) to bring the house to net-zero status: producing at least as much energy as it uses.

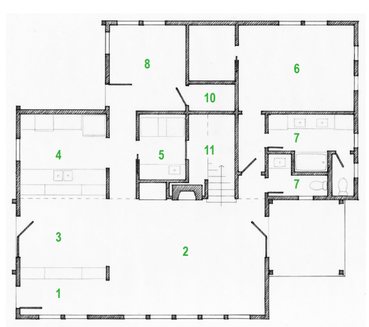
SOLAR STRATEGIES: SUN ANGLES FOR OPTIMIZED SHADING IN SUMMER AND WINTER [1] AND IMPLEMENTING IDEAS OF THERMAL MASSES [2]

SECTION PERSPECTIVES THROUGH THE KITCHEN [1], THE LIVING SPACE [2] AND THE MASTER BEDROOM [3]

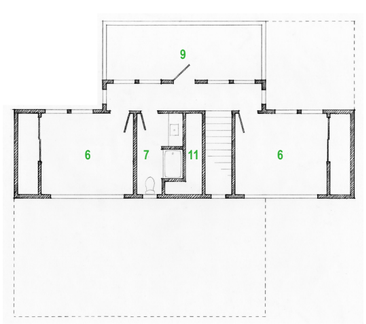
PRELIMINARYDEFINITION
A SMART BUILDING IN A VERNACULAR STYLE

The definition of this project is based on our American housing market research on prefabricated energy efficient homes. Consequently, the Clemson Zero Energy House was defined to have traditional architectural styles, but also have a modern feel while incorporating passive heating, cooling, and ventilation systems. The design options were deliberately limited in order to avoid overwhelming the homeowner with choices, while still allowing enough options to engage them into the design process. The costs were estimated to be as all-inclusive as possible, and within an average American's budget using local manufacturing companies and techniques. All of these considerations led to a unique building design and final concept that is representative of a typical American taste and budget while maintaining an innovative spirit and achieving a high level of energy efficiency.



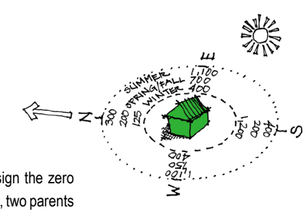


GROUND FLOOR



FIRST FLOOR

1. ENTRY
2. LIVING
3. DINING
4. KITCHEN
5. LAUNDRY
6. BEDROOM
7. BATHROOM
8. FLEX ROOM
9. ROOF TOP TERRACE
10. STORAGE
11. MECHANICAL



DESIGNGOALS
REDUCED TO THE MAX

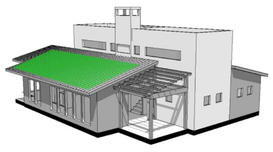
Based on the evaluation of the existing housing market, we decided to design the zero energy as a living space for a typical "2+2" family: two parents and two children, two parents and two grandparents, four college students, etc. Our research determined that the house has around 2,000 square feet; 20% smaller than an average American household. With an eye towards sustainability, we eliminated spaces that are seldom occupied but have become standard add-ons in today's "more-is-more" building culture. The house contains three bedrooms, two bathrooms, a bonus room, a generous living space and plans for a garage or carport. The solar orientation of the house – the relationship between the house itself and the sun's path – was considered for implementation of passive heating and cooling techniques. The master suite is located on the ground floor in a separated, private part of the house, while the other two bedrooms are on the second floor. All servicing functions that include plumbing, such as the kitchen, bathrooms, and laundry, as well as the mechanical systems, are positioned as close together as possible to promote efficient use of space. Extra amenities incorporated in our design include vaulted ceilings, outdoor spaces, and a fireplace.

COSTGOALS
MARKETABLE AND AFFORDABLE

According to the United States Census, the median sales price for a new single-family home in the United States in 2005 was $240,900. The median sales price for a new single-family home in the South was less, only $197,300. The census also indicates that roughly 20% of these homes nation-wide (47% of Southern homes) fell into a $100,000 to $199,999 price range. Our goal for the Clemson Zero Energy House was to find a structural and architectural plan that fit all of our design goals and could be constructed for approximately $150,000. An initial construction estimate for our design indicated that with common building materials, we could construct this house for around $143,000; $7,000 less than our $150,000 goal. More research is being completed in insulation and other materials choices in order to best take advantage of material technologies while staying within our budget.

PROVISION FOR VENTILATION: WIND INDUCED FLOW [1] AND STACK EFFECT [2]

ZEROENERGYHOUSE
CLEMSON UNIVERSITY | SCHOOL OF ARCHITECTURE



ENERGYGAIN
PHOTOVOLTAICS

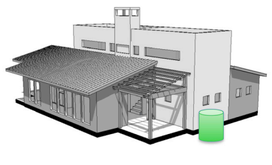
The Clemson Zero Energy House, when built, will be a house approximate 30 percent more efficient than an average new home built with conventional construction and architectural techniques. Additional technologies can be added to the house in order to create the reminder of the energy necessary for the building to be considered "net zero" – creating as much energy as it uses. One common energy gaining technology in the Southern United States is the use of photovoltaic cells to collect and store solar energy. Adding a photovoltaic system to the Clemson Net Zero Energy House would be one way for the homeowner to take the original energy efficient building and make it less dependent on an external energy grid.

PV SIZE + COST ESTIMATES FOR

100% ENERGY OFFSET
[AND FIXED SOLAR RADIANCE
OF 5.06 KWH/ SQM/ DAY IN CLEMSON]

1500 KWH/MONTH
SYSTEM SIZE: 12.29 KW
ROOF SIZE: 1229 SQ FT
COST: $86,047.28
+30 % FEDERAL TAX CREDIT
+3,500 STATE TAX CREDIT
= $56,733.09

1000 KWH/MONTH
SYSTEM SIZE: 8.19 KW
ROOF SIZE: 819 SQ FT
COST: $57,364.85
+30 % FEDERAL TAX CREDIT
+3,500 STATE TAX CREDIT
= $36,655.40



WATERCOLLECTION
CISTERNS

One active strategy ready to be employed with the Clemson Zero Energy House is rainwater collection. Rainwater collection is a process by which rainfall is collected off the roof of a house in order to be reused in other places. The rainwater collected can either be used unfiltered to water the lawn, or can be filtered in order to be used in the house for washing clothes, doing dishes, or even drinking. In South Carolina, a rainwater collection cistern is normally kept outside because of the expansion and contraction of the clay soil during the course of the year. This collection system could therefore be applied to almost any site chosen for the Zero Energy House, without regard to the depth of the water table or any other geological concerns involved with burying the cistern.

SUPPLY [IN GALLONS]		INCHES OF RAINFALL		0.623		CATCHMENT AREA [SQ FT]	RUNOFF COEFFICIENT
	X		X		X		
	X						
		54.8 INCHES		0.623		1789 SQ FT	0.75
			X		X		
=		**45.808 GALLONS PER YEAR**					
=		**3,817 GALLONS PER MONTH** [81% OF THE AVERAGE WATER USAGE OF A EUROPEAN (UK) 4 PERSON HOUSEHOLD]					

ULRIKE**HEINE** | Aaron Swiger | Adam Wilson | Alexander De Fee | Bailey Whisler | Barak Yaryan | Benjamin Higgins | Dan Harding | Eric Dudley | Garth Brown | Jake DeMint | Jared Moore | Kelly Sprague | Laura Blumenfeld | Michael Cook | Rebecca Shields | Regina Pencile | Sara Damiani | Shannon Calloway | Vincent Blouin

Ulrike Heine is Assistant Professor of Architecture since August 2007 and teaches design studio. Her approach on architecture in teaching and research are based on sustainability, in the way of applying simple natural laws in reaction to climatic conditions. She teaches architectural design as a process of integration, which means materials and construction as well as lighting, acoustics and energy saving technologies are creative tools in this process.
Ulrike Heine graduated with a master of architecture from the Brandenburg Technical University in Cottbus (Germany) in 1999, having also spent a period of her studies at the School of Architecture in Barcelona (Spain). She worked as a practicing architect inter alia for the German architectural practice Hascher Jehle Architektur in Berlin. Prior to coming to Clemson, she spent three years teaching Design, Construction and Energy Responsible Planning at the Technical University Berlin (Germany).

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