Interdisciplinarity as a Sustainable Pedagogical Tool

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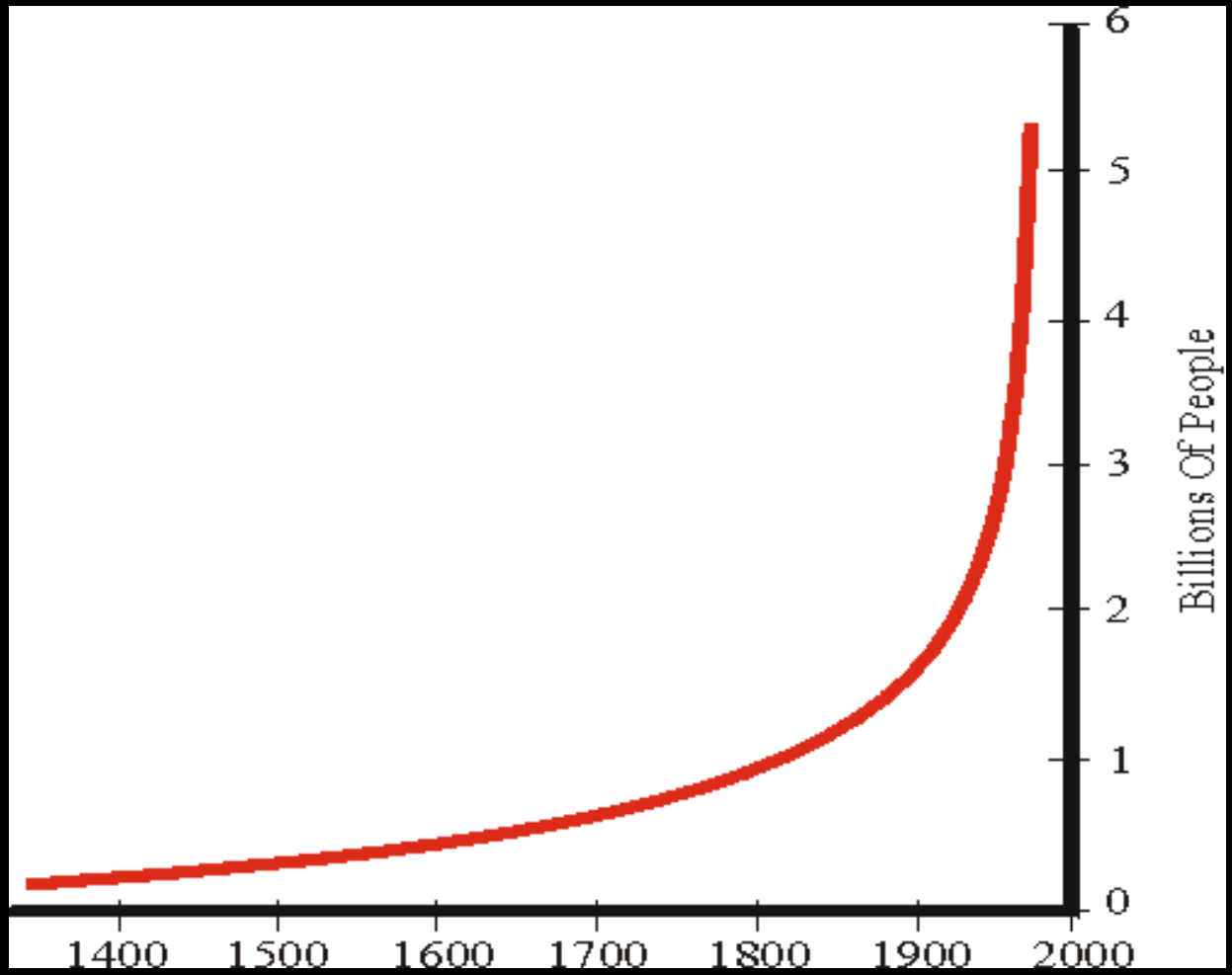
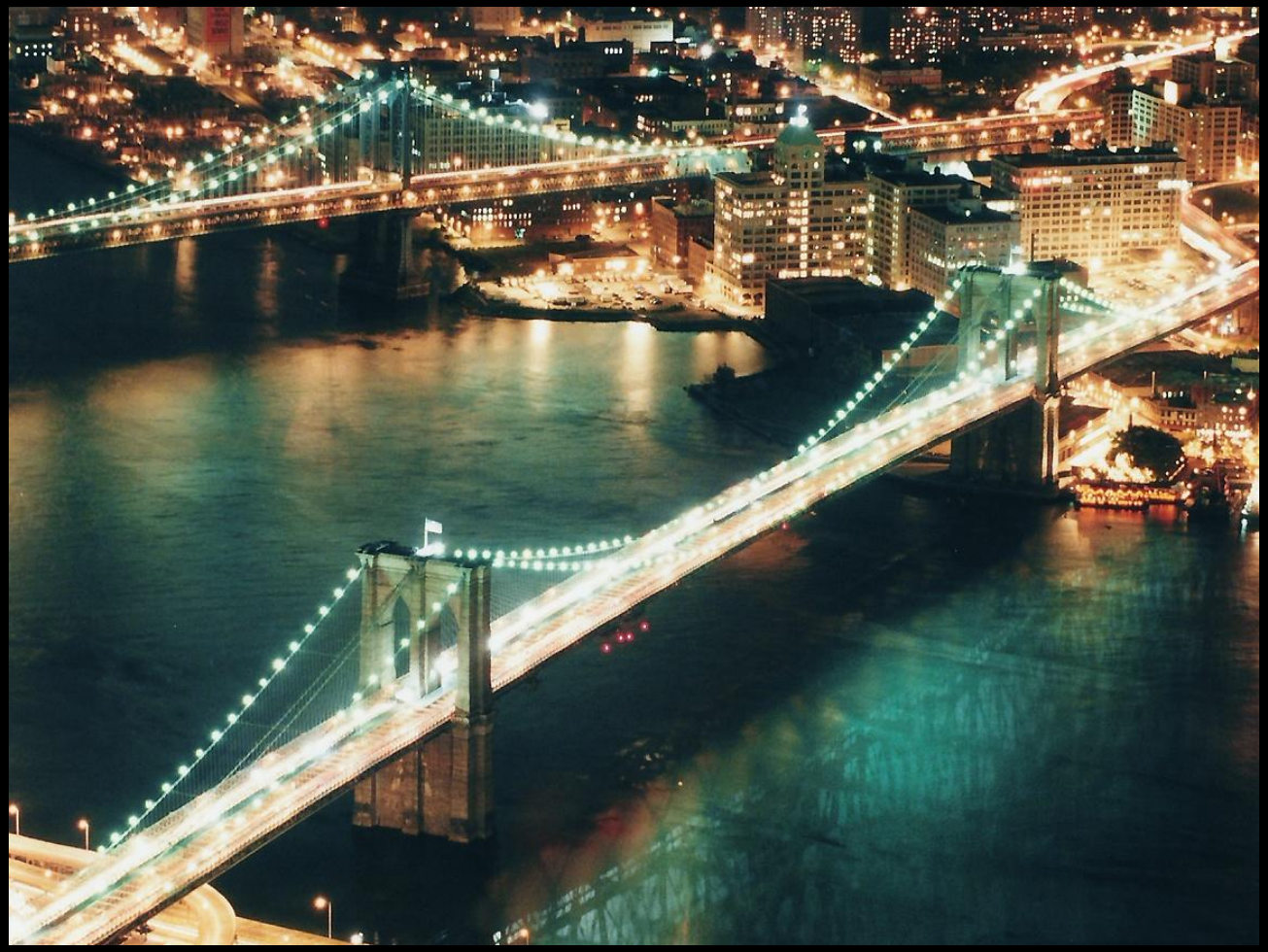
"Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs."

-the United Nations World Commission on Environment and Development

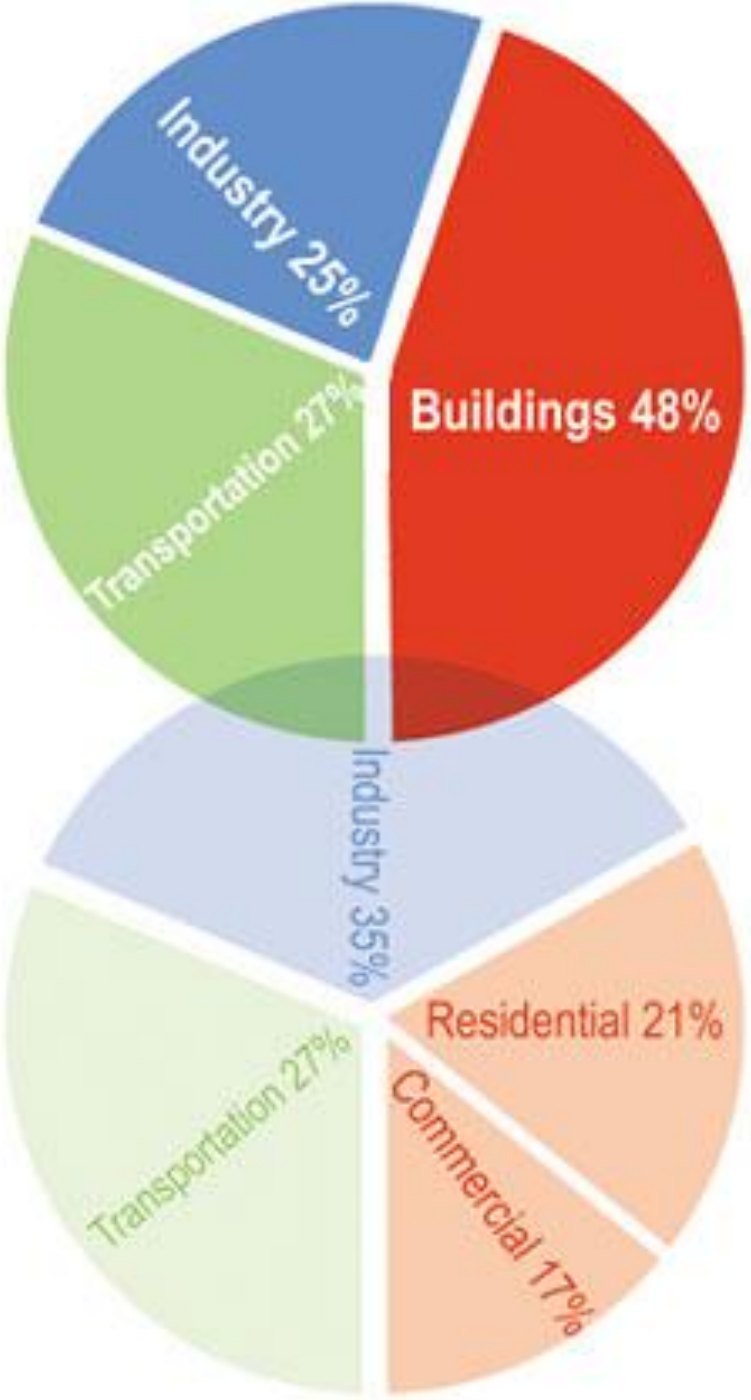
Sustainability: possibility?



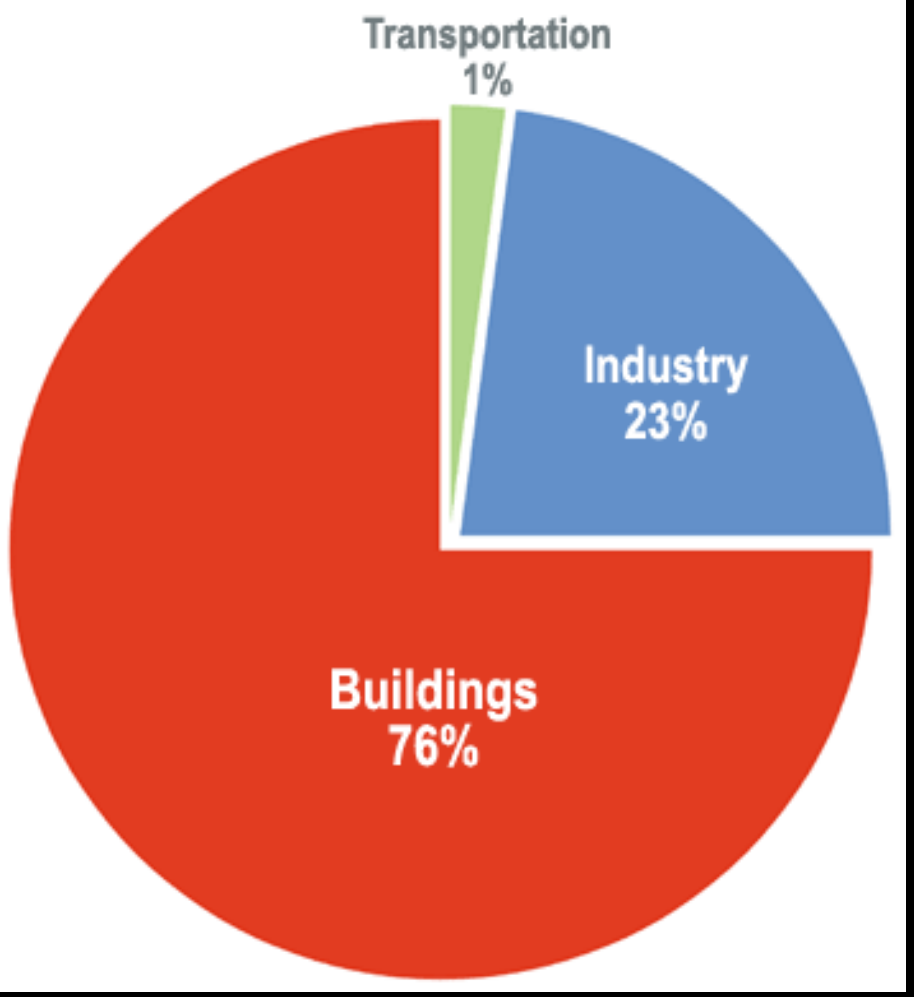
Buildings consume a significant proportion of energy used in the U.S.



Overall US energy consumption



source: architecture2030.org



Overall US electricity consumption

source: architecture2030.org

Buildings consume a significant proportion of energy used in the U.S. Reducing building energy use, then, is an important strategy towards a sustainable society.

Five principles of an environmental architecture

- (Thomas A. Fisher, AIA, November, 1992)

* Healthful Interior Environment.
  - Safe
  - Accomodating
* Energy Efficiency.
  - Small energy footprint
  - Wise use of energy
* Ecologically Benign Materials.
  - Sustainable resource use
  - Low site impact
  - Low environmental impact
* Environmental Form.
  - Passive strategies
* Good Design.

Sustainable decision-making

* *Healthful Interior Environment.*
  - *Safe*
  - *Accomodating*
* *Energy Efficiency.*
  - *Small energy footprint*
  - *Wise use of energy*
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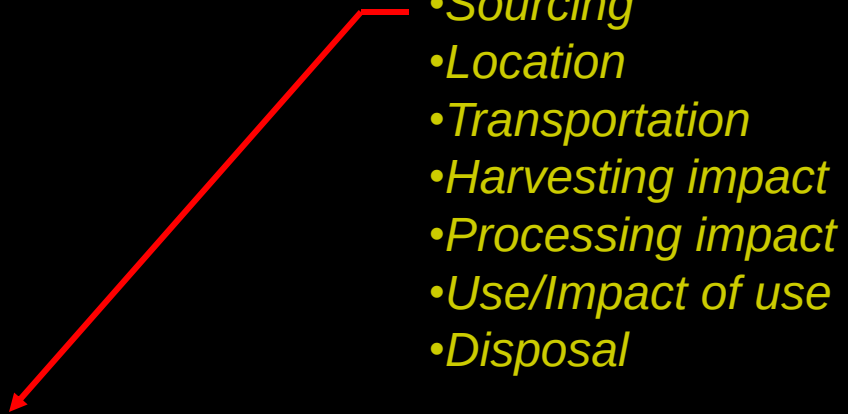
  - *Passive strategies*
* *Good Design.*



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  - *Low site impact*
  - *Low environmental impact*
  - *Environmental Form.*
  - *Passive strategies*
  - *Design.*

- *Sourcing*
- *Location*
- *Transportation*
- *Harvesting impact*
- *Processing impact*
- *Use/Impact of use*
- *Disposal*

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How do we prepare students for sustainable decision-making?



“thick” decision-making

- *cross-disciplinary considerations*
- *avoids “universality” of one discipline’s viewpoint*
- *objective, impartial, generalizable assessment to foster correct results to complex problems*

interdisciplinarity

- *Initiatives that cross disciplines*
- *Provides broad inquiry into complex problems*
- *Solution set validated by multiple groups*

Project Solar House

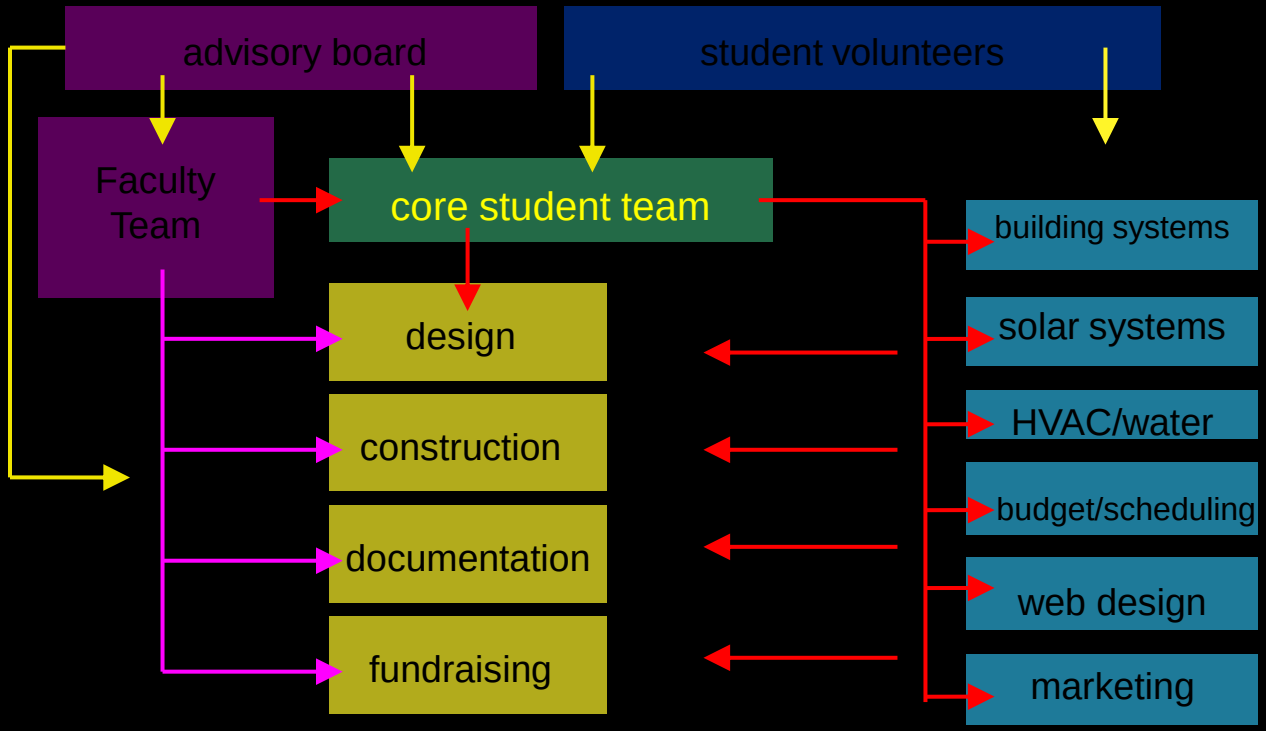
Kansas State University
University of Kansas


SOLAR DECATHLON
A DESIGN COMPETITION FOR HOMES
POWERED BY THE SUN


OPEN

Project decision map

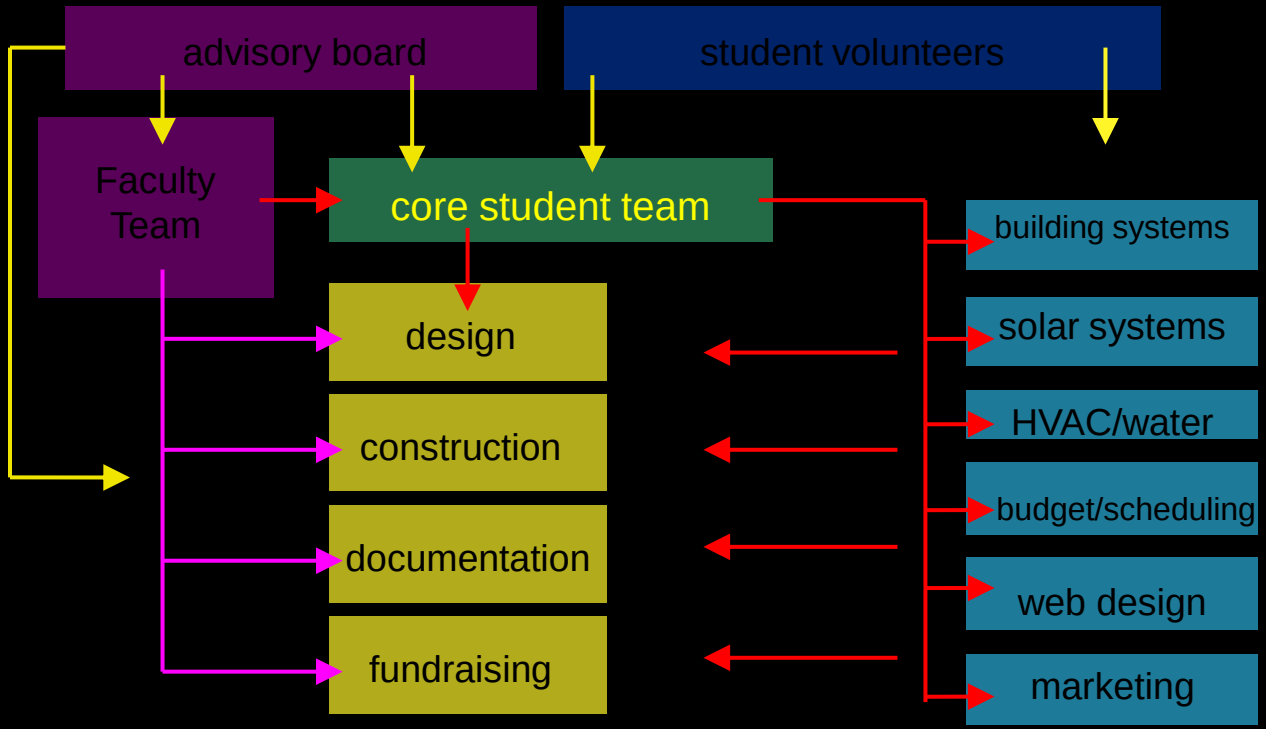
Primary stakeholders: architecture (KSU) & architectural engineering (KU)



Core student team – curricular units

architecture students in studios

engineering students in labs & other classes



Curricular units

Architecture

Spring '06	Design Development
Fall '06	Construction Documents
Spring '07	Construction
Fall '07	Competition

Interior Architecture

Fall '07	Design and Construction of Interior Furnishings

Landscape Architecture

Fall '06-Spring'07	Sustainable Landscape Systems

Electrical Engineering

Fall '06	Solar System Design

Mechanical Engineering

Fall '06	HVAC Design
Spring '07	Construction & Installation of HVAC

Architectural Engineering (KU)

Spring & Fall '06	Preliminary & Final Energy Analysis

Project Solar House – Design Process

Energy efficiency
Renewable energy strategy
Design of HVAC system

Energy Efficiency

architecture (KSU)
architectural engineering (KU)

Energy Efficiency

architecture (KSU)
architectural engineering (KU)

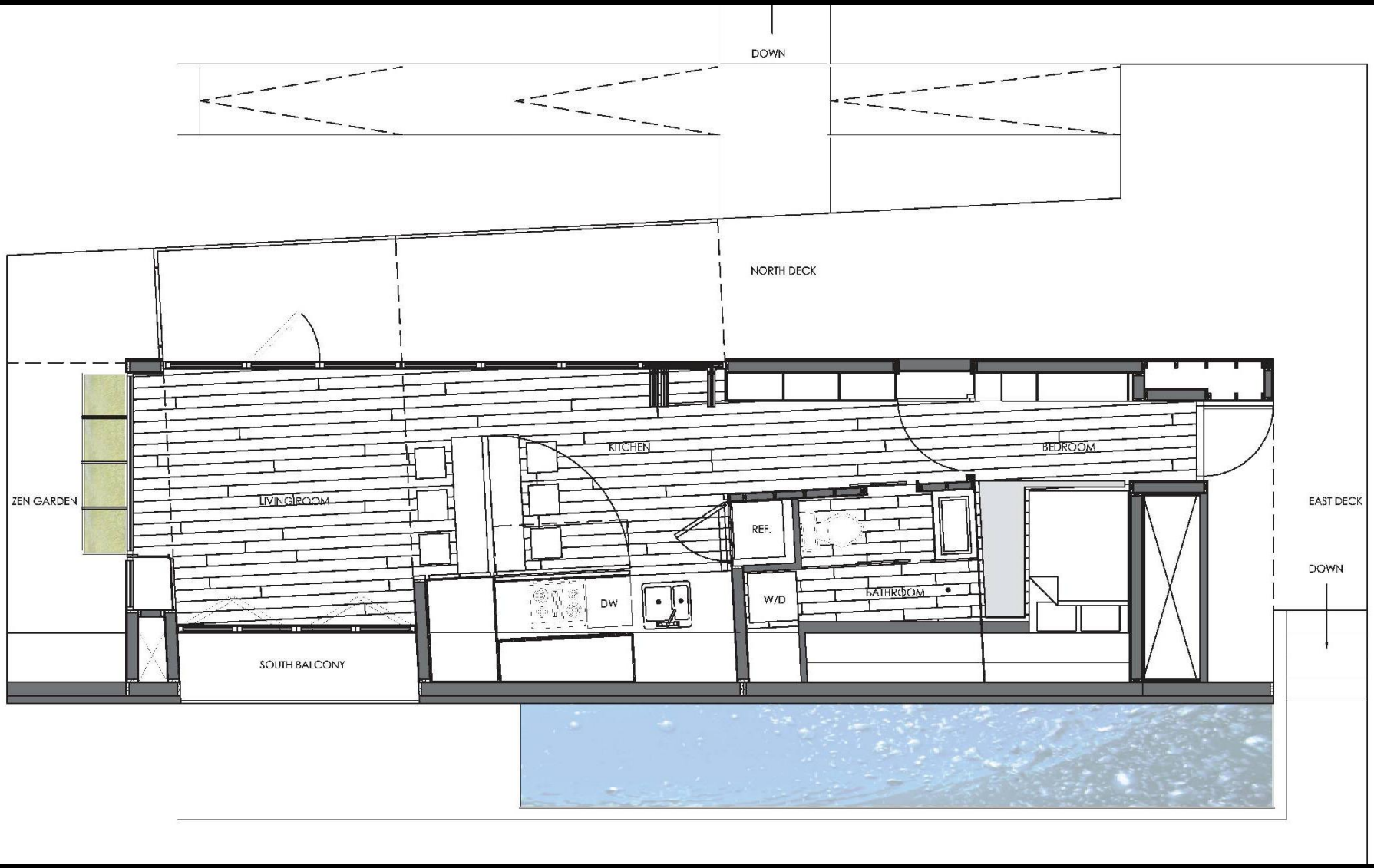
goals: *reduce energy use through building envelope design*
redirect expectations in regard to energy use
maximize usable ambient energy
minimize detrimental external loads

Energy Efficiency

Compact size

Environmental Form

Compact size



Energy efficiency

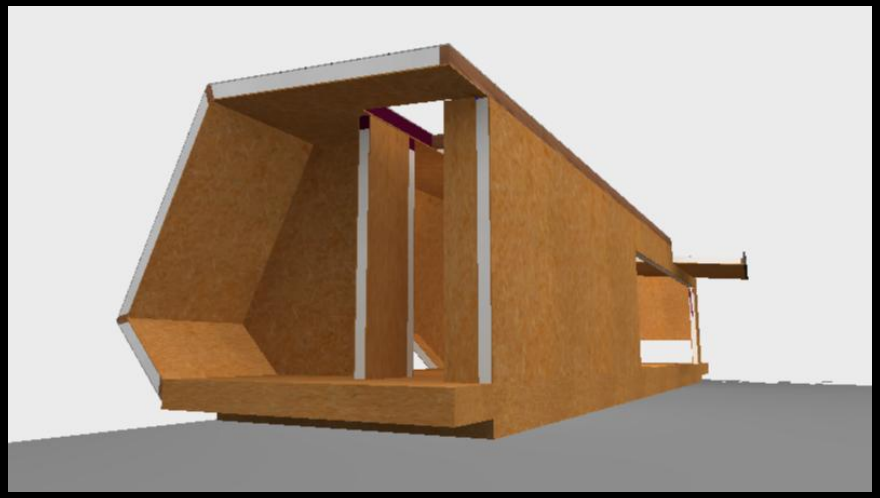
Turning one's back to the sun

Energy Efficiency

Turning one's back to the sun

Energy Efficiency

SIPs



Energy Efficiency

SIPs

Energy Efficiency

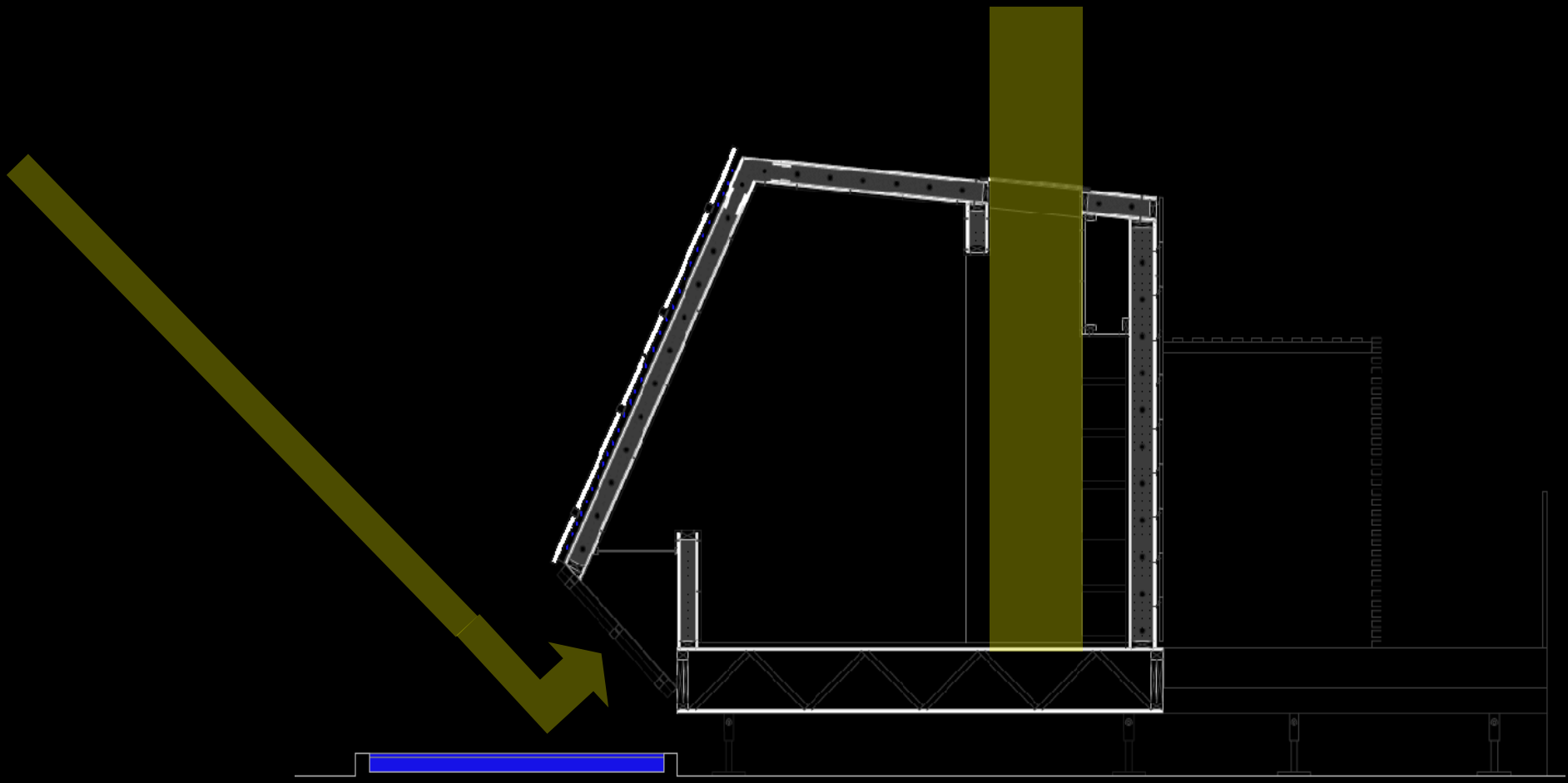
Metal roof

Energy Efficiency

Metal roof

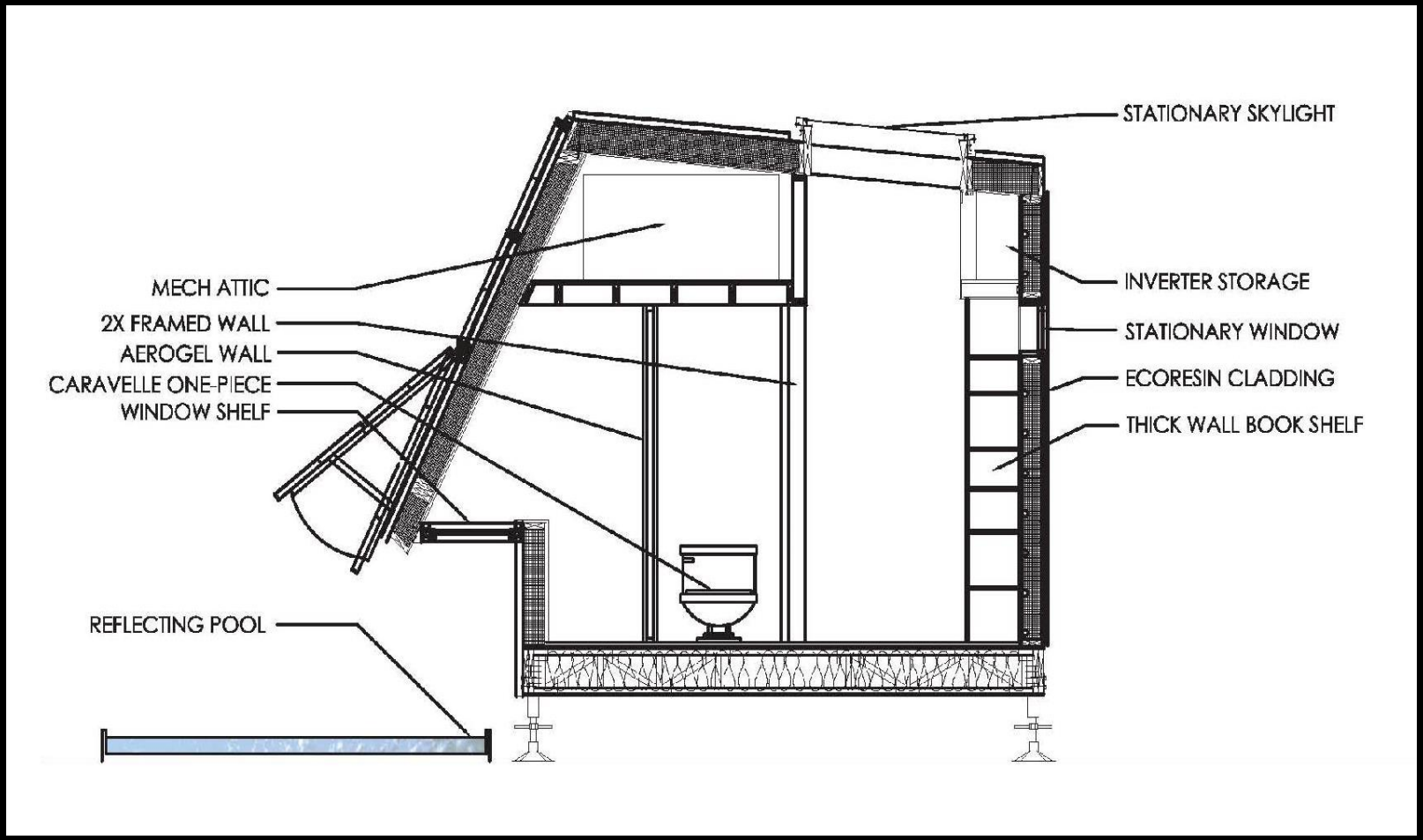
Energy Efficiency

daylighting – indirect light



Energy Efficiency

daylighting



Energy Efficiency

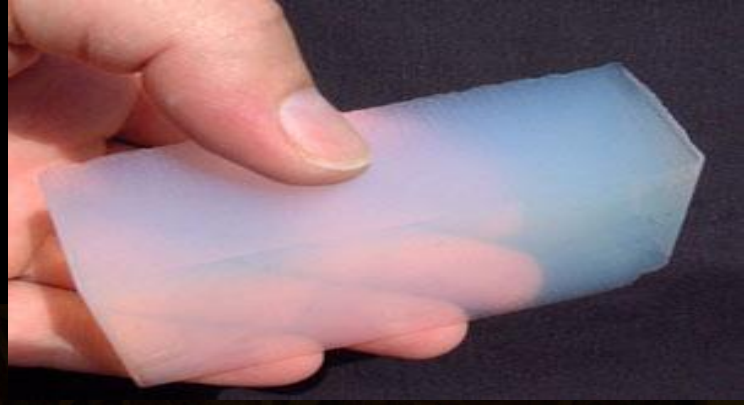
daylighting – vertical glazing

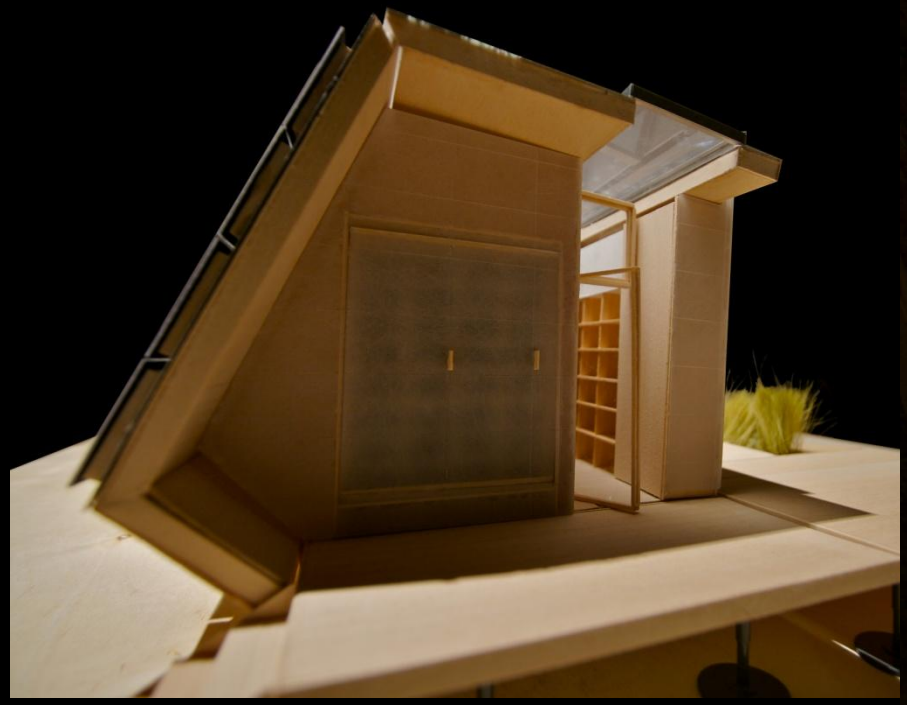
Energy Efficiency

daylighting – vertical glazing

Energy Efficiency

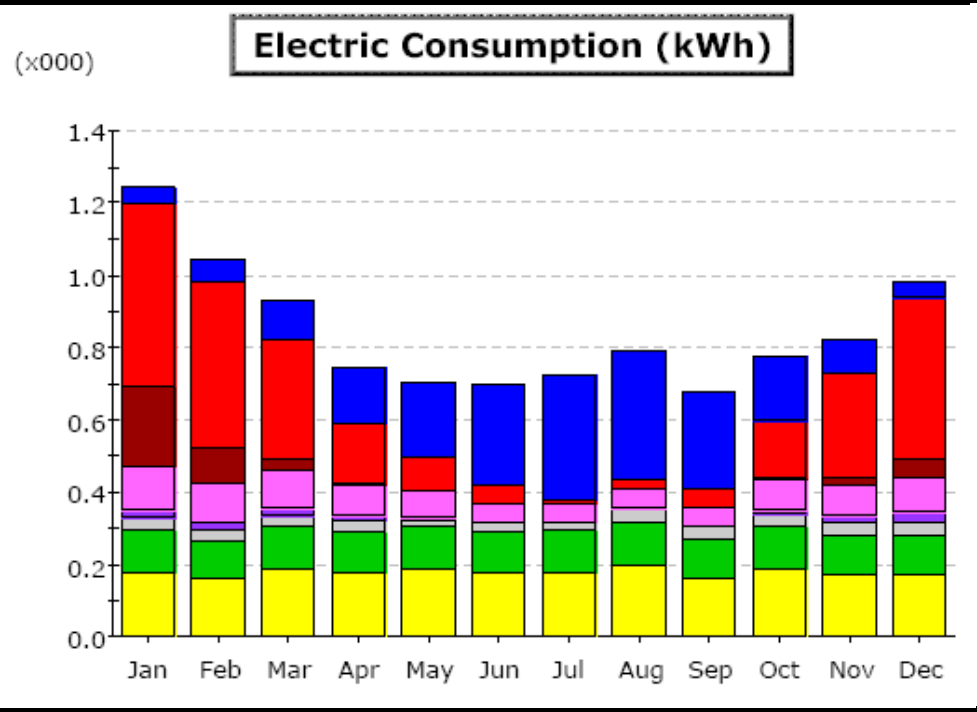
daylighting - skylights



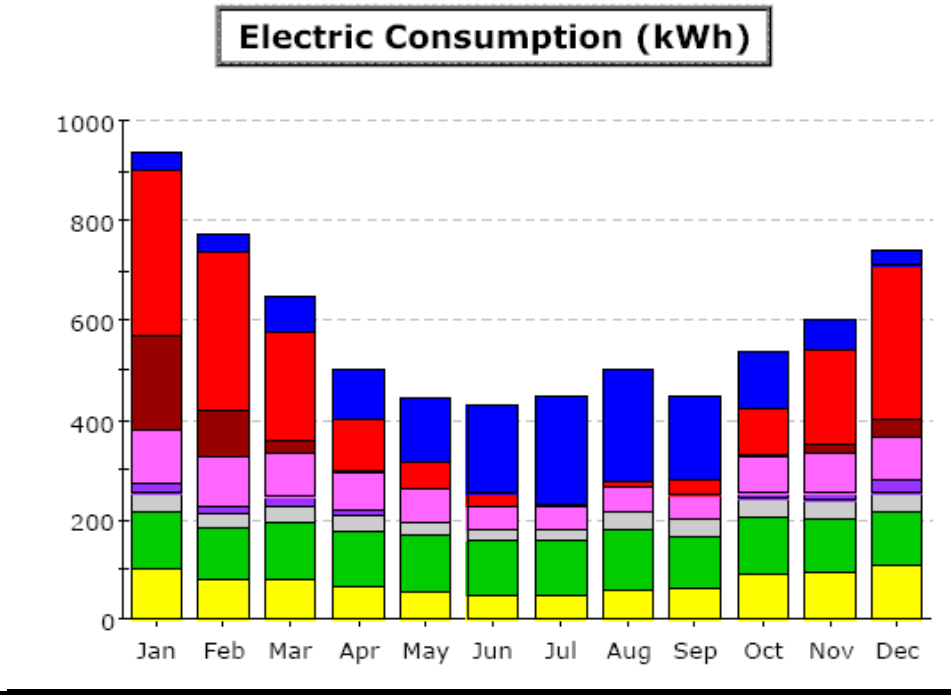


Energy efficiency

Energy Simulation



Base case – 10,130 kW-hrs



EEM case – 7,003 kW-hrs

Renewable Energy

electrical engineering (KSU)
architecture (KSU)

goals: *provide all power needed*
allow PV system to have presence in design & occupant experience
PV system as educational tool

On-site Renewable Energy Production

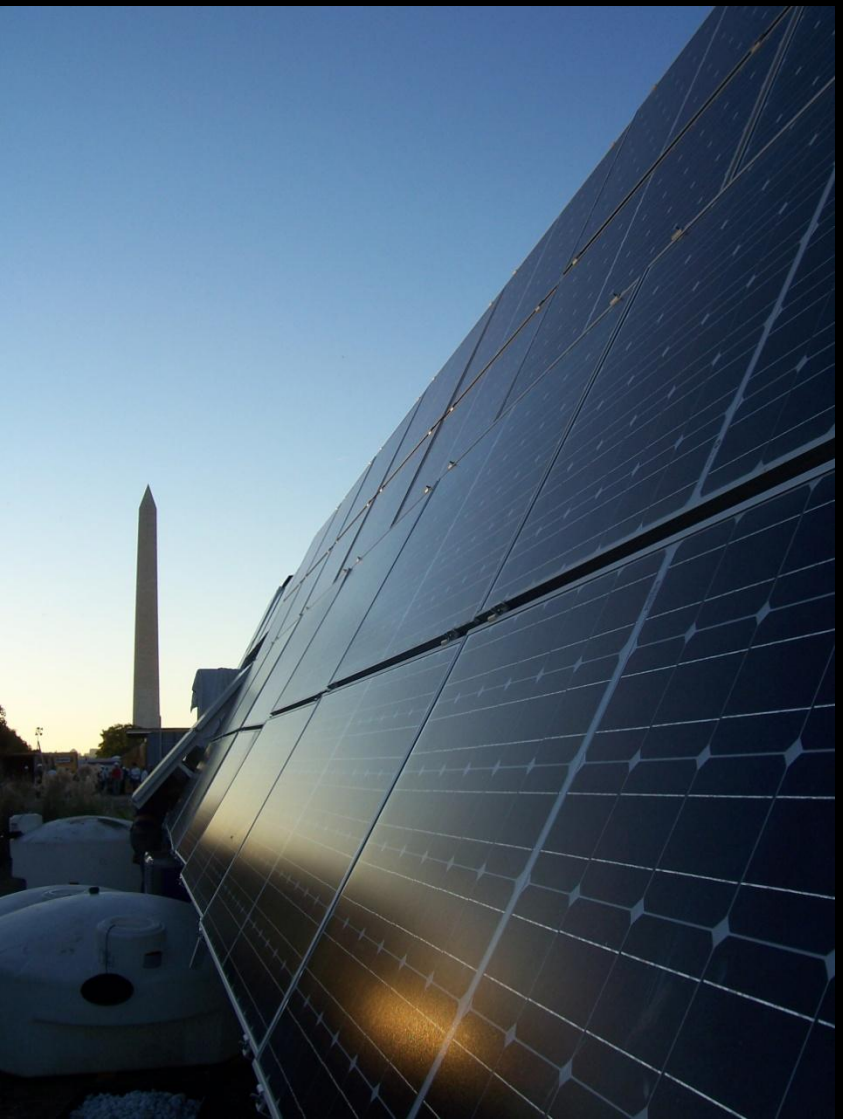
Building integrated photovoltaics

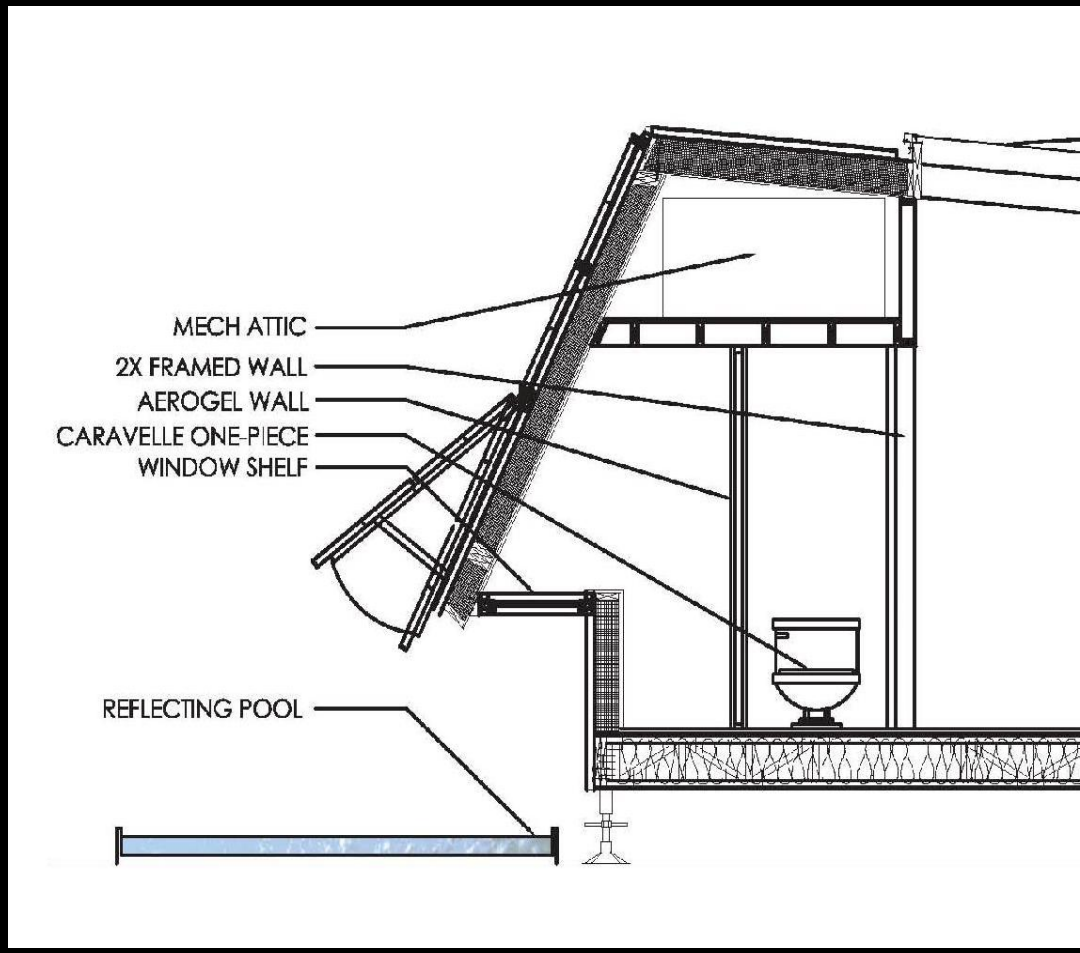
Renewable Energy

Building integrated photovoltaics

Renewable Energy

64 degree angle “sun wall”





Renewable Energy

Building integrated photovoltaics

HVAC System

architecture (KSU)
mechanical engineering (KSU)

goals: *provide optimal thermal conditions*
minimize energy use
maximize control

HVAC System

Decision matrix

goals: *provide optimal thermal conditions*
minimize energy use
maximize control

Criteria	Weight	**Concept A** *(Standard Heat Pump Dehumidifier Economizer)*	**Concept B** *(Standard Refrigerator Dehumidifier Economizer Heater)*
Power Efficiency	10	**DATUM**	-
Temperature	8		S
Humidity	8		S
Air Quality	8		S
User Interface	3		S
Unique Design	5		-
Reliability	8		S
Budget	4		+
Appearance	2		S

HVAC System

Decision matrix

goals: *provide optimal thermal conditions*
minimize energy use
maximize control

Outcomes & Recommendations

student responses

- *broadened understanding & sensitivity to decision-making*
- *team-building & interpersonal skills*
- *heightened concern for sustainability*

interdisciplinarity at K-State

- *good job at intra-college collaboration & at foundational level*
- *NRES secondary major, Honors system*

incorporate interdisciplinarity in curricula

- *identify common educational goals*
- *identify skills that will advance sustainable approaches*
- *make collaboration a priority*

+ Contact Information

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