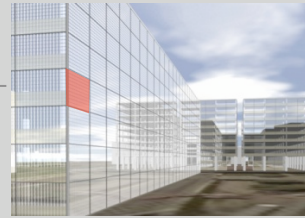




Solar Façade System



EPA grant

Low Energy Prefabricated Housing



NSF grant

Solar House Prototype



Internally funded

Solar Air Thermal Flue Systems



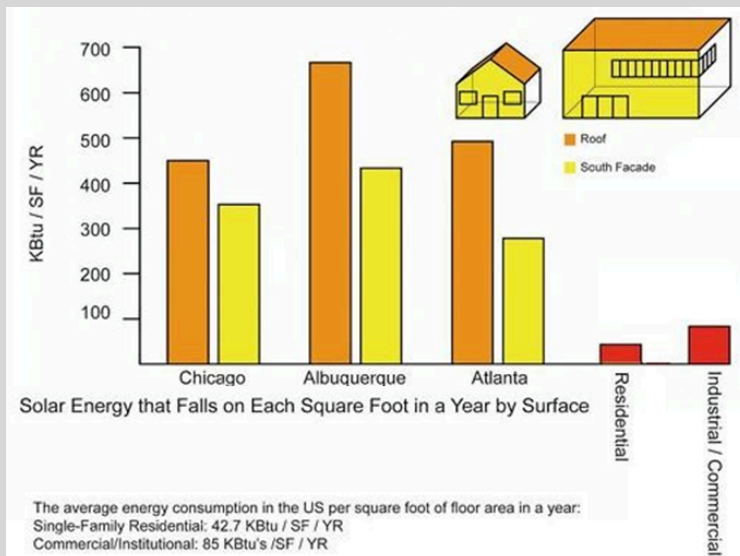
NSF grant

Future concepts for sustainable building façade systems

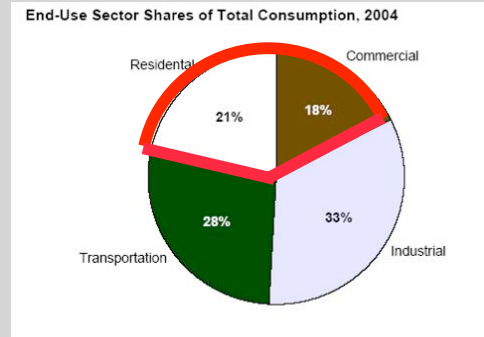


Building's environmental impact

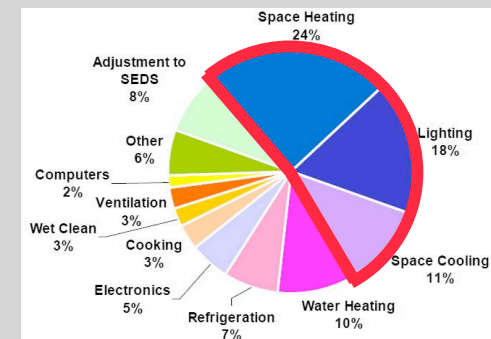
- ❑ **Energy consumption:**
Buildings - 40% of total annual energy consumption
- ❑ **CO2 emissions:**
Buildings - 38% of total US CO2 emissions
- ❑ **Solid waste generation:**
Building construction and Demolition - 24% solid waste



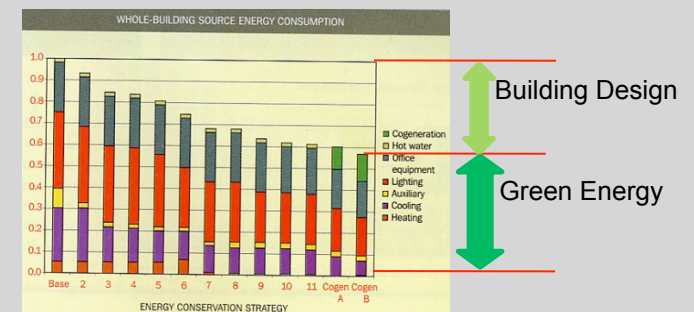
Energy by **exposure** and energy **potential**



Energy use by **sector**



Energy use by **function**



Energy use reductions by **design**

Strategy:

- ❖ Reduce building energy consumption
- ❖ Implement passive solar design

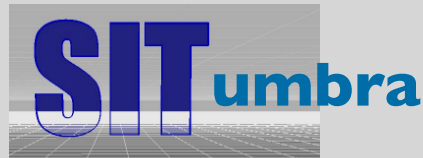


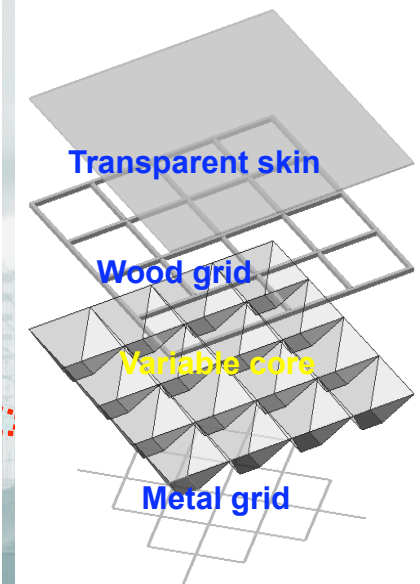
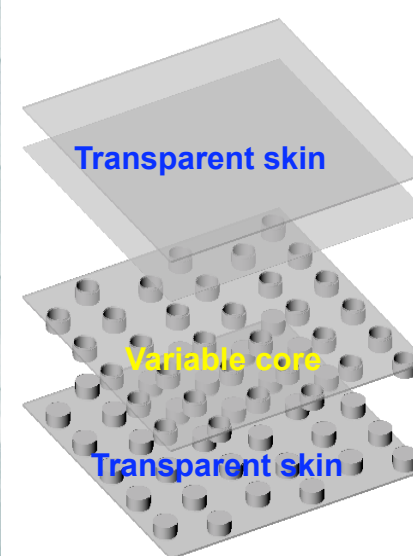
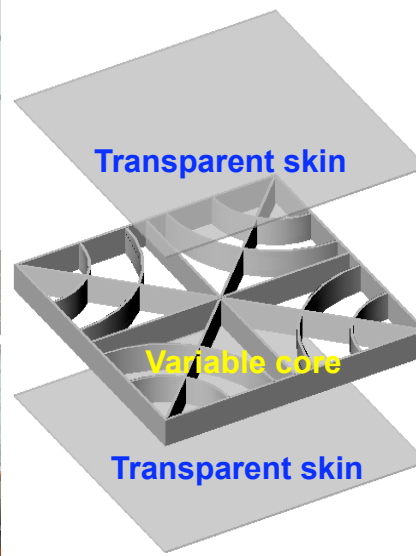
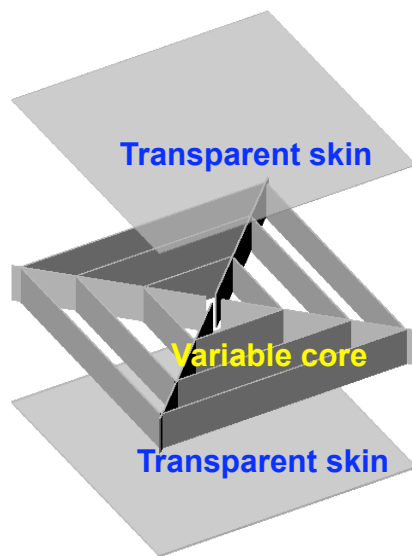
Means:

- Improve envelope **thermal efficiency**
- Integrate **structural shading** system
- Customize to environmental **location**



Structurally Integrated Transparent Passive Solar Façade System







2006 P³ Award Winner

U.S. Environmental Protection Agency

P³ award
people, prosperity, and the planet



Structurally Integrated Transparent Passive Solar Façade System



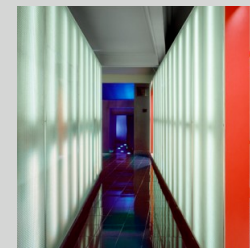
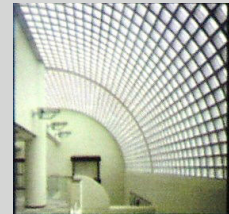
Thabman College of Architecture and Urban Planning

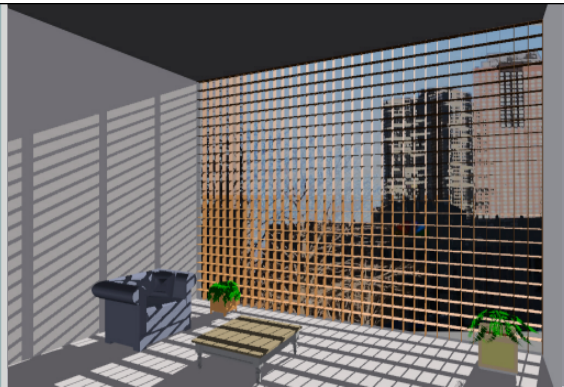
Michigan Engineering

U.S. Environmental Protection Agency



- customizable structural window and wall system
- multiple material and design specifications
- improved building energy performance
- integrated structural shading

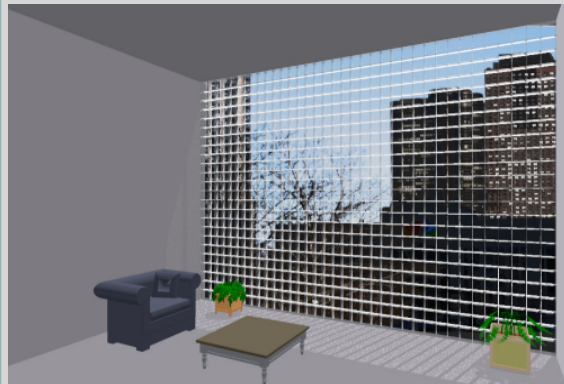




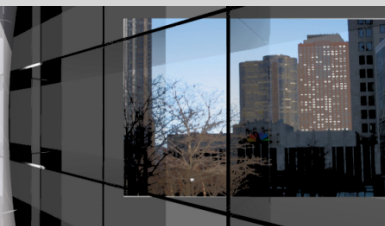
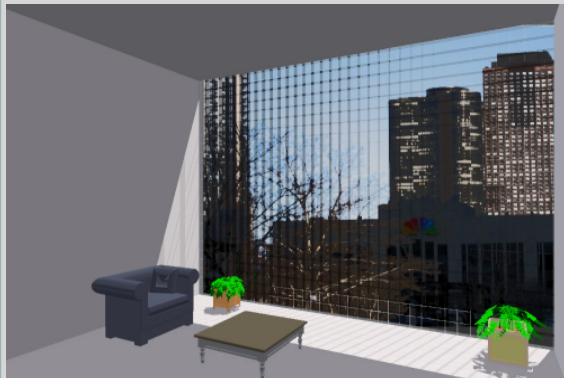
Summer Equinox Winter



Opaque

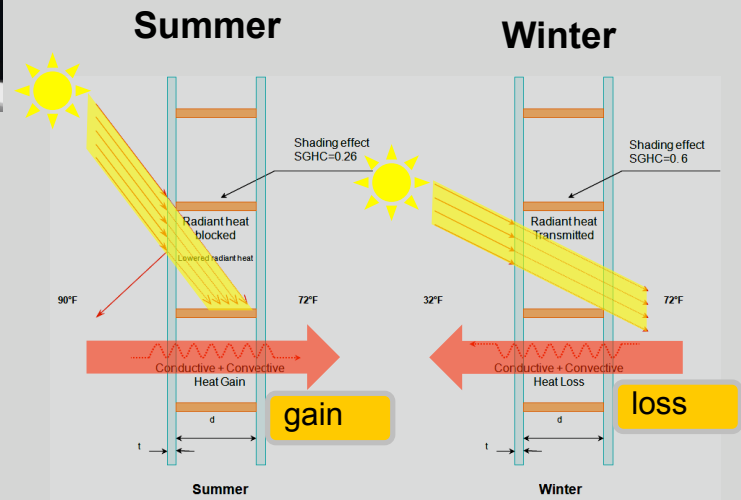


Translucent

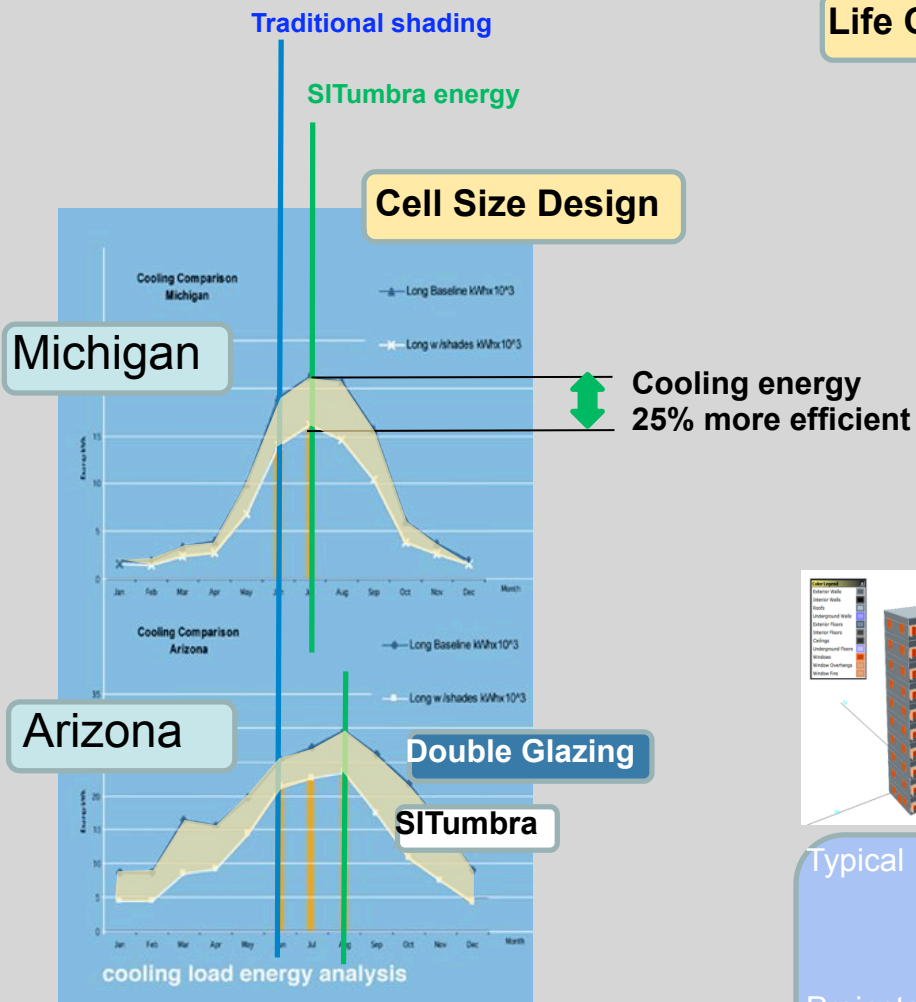


Transparent

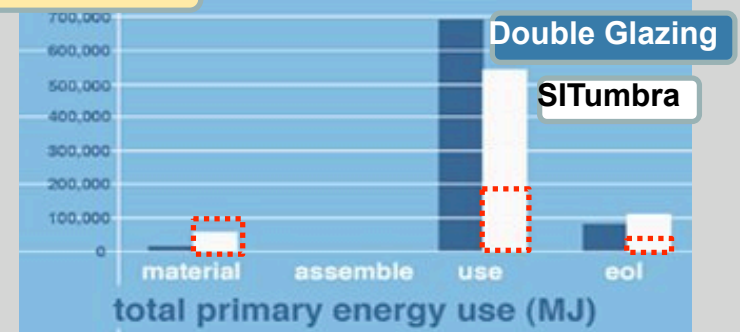
- ☐ energy efficient façade system
- ☐ seasonal passive energy transfer
- ☐ agricultural based materials
- ☐ large number of variant possibilities
- ☐ new architectural aesthetic



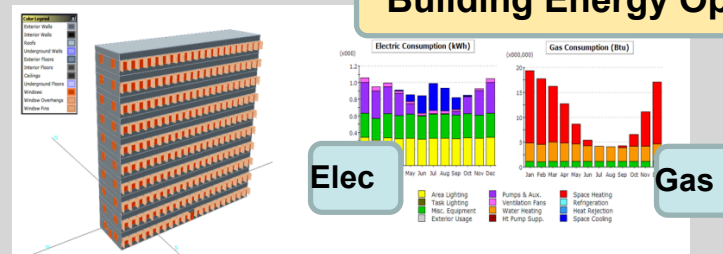
Solar shading and transmission



Life Cycle Analysis

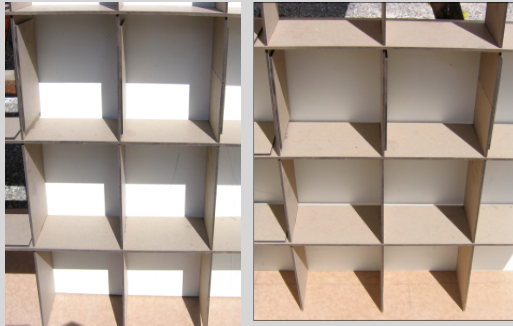


Building Energy Optimized

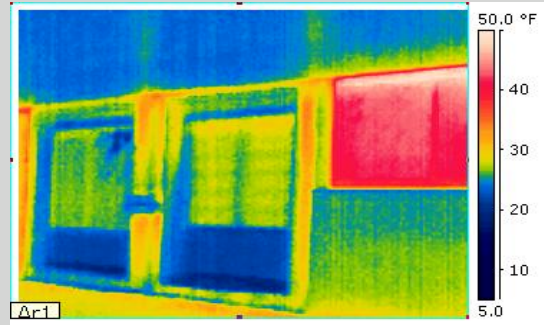


Typical 10 story office = 52,000 sq.ft.
 Building cost = \$10 million
 Energy Use = 1,000,000 kWh/yr
 Energy Cost = \$86,000/yr

Projected:
 Energy Life Cost = \$2.5 million
 Energy Life savings= \$500,000



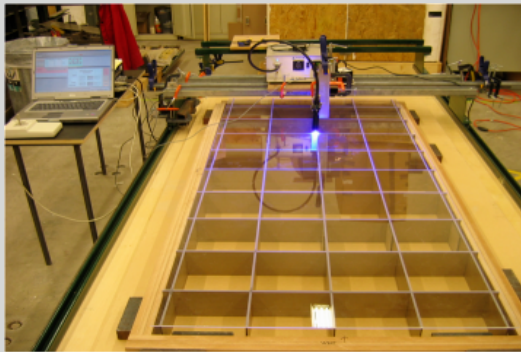
Parametric shading optimization



Thermal imaging



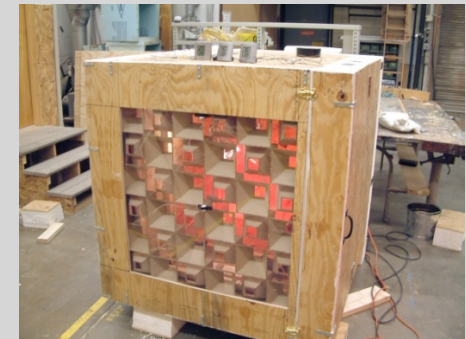
Installation trials



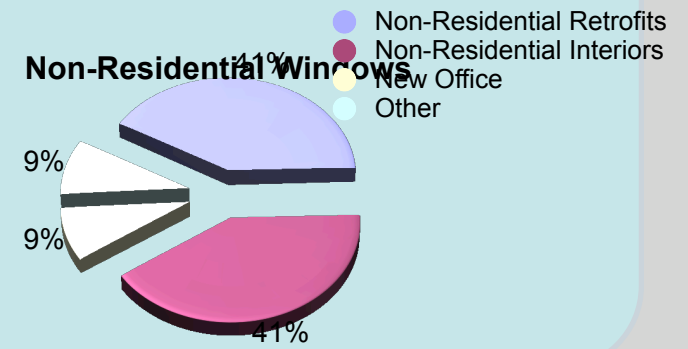
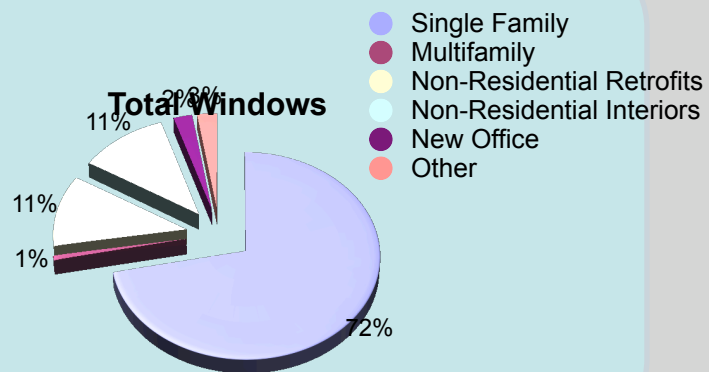
Automated manufacturing



Core and skin detail



Thermal testing



The architectural window market in the US is estimated at \$33.7 billion per year

Market Analysis

- ❖ Single family home construction - 72% of the total market.
- ❖ Retrofits, interiors, and new office construction - most significant markets.
- ❖ Market penetration strategy → retrofit and interior markets → new office projects
- ❖ The architectural window market → 31.2 million units or 717 million square feet per year.
- ❖ With only a small initial share - SITumbra has large business potential.

Product and Service Sectors (- who wants this product?)

Architectural

- Curtainwalls – large-span transparent windows
- Skylights – overhead transparent windows,
- Traditional windows – replacement of traditional window systems

Interiors and Retrofits

- Interiors – transparent/translucent partitions for interior rooms and space divisions
- Retrofits – insertion of new light

A new company startup is expected achieve \$200 million in profits by year 10

Structural

- Flooring – transparent flooring in
- Modular buildings – used in conjunction structurally integrated panels (SIPs) for walls
- Temporary structures – exhibit, emergency, and other freestanding temporary structures
- Roof-wall systems – thin shell type structures that combine shading and transparency

Advanced Applications

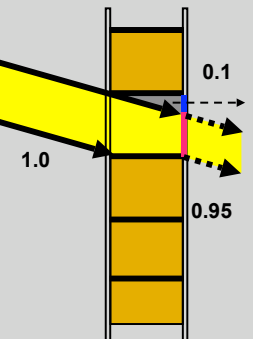
- Environmental materials – biocomposites and recyclable materials
- High-performance materials – advanced materials to achieve high strength and energy efficiency

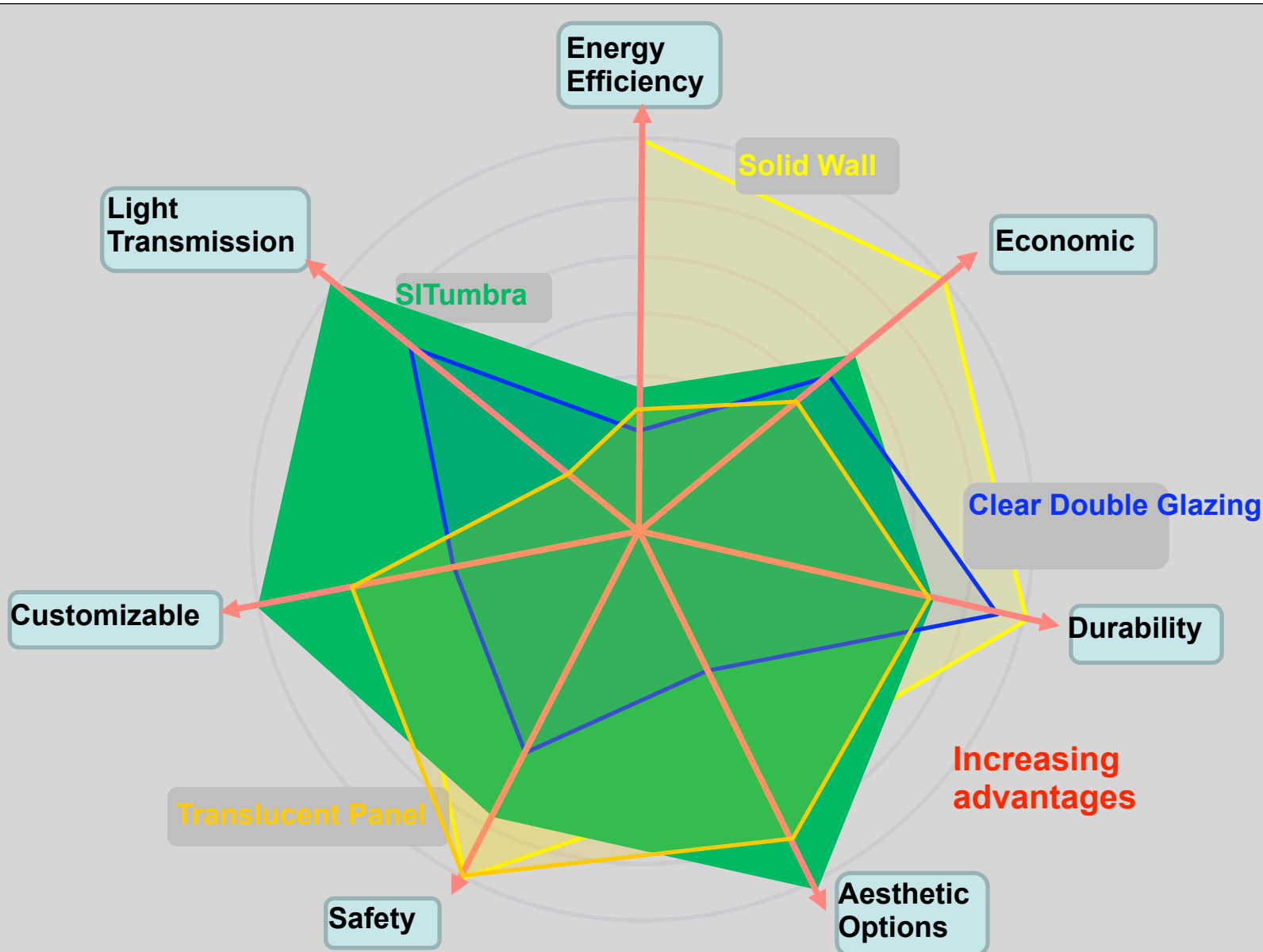
Customization Service

- The ability to achieve different requirements relies on customization
- Customization is a significant service overlaying the variety of product opportunities.
- Find a balance between providing standard systems and opportunities for customization

Customer Needs	Standard glazing	SITumbra
Energy Efficiency	Requires double and triple glazing - added low e coatings - thermal breaks to mullions.	System inherently double glazed - no thermal bridge, - no low e coatings and more efficient
Solar Performance	Low - requires low e coatings - inefficient in winter	High - variable passive response - shading limits summer heat gains
Safety	Requires laminated / tempered glass	Inherent impact resistance

- ❖ Functional strength - structural, visibility, energy, and mass customization
- ❖ A special manufacturing process used to produce the system at a low cost
- ❖ Automated customization allows system to be tailored to customer needs
- ❖ Existing companies focus on mass manufactured products
- ❖ Simplicity and unique customization ability at a competitive cost





Technology disclosure

- facade system
- structurally integrated cell core and surface
- patterned group core elements
- core solar and structural function
- core geometry optimization to site location
- customizable to planar and curved surfaces

Patent

expected to be filed this year.

Small business startup

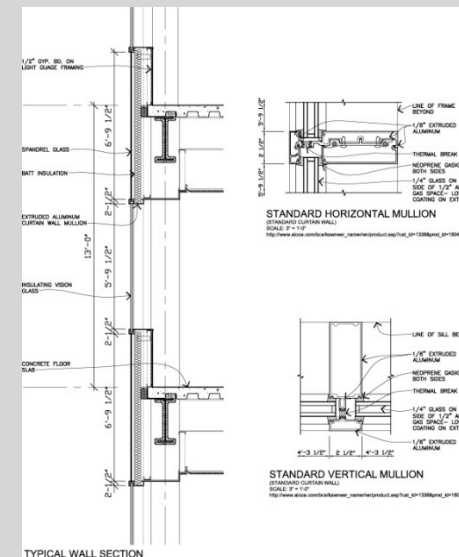
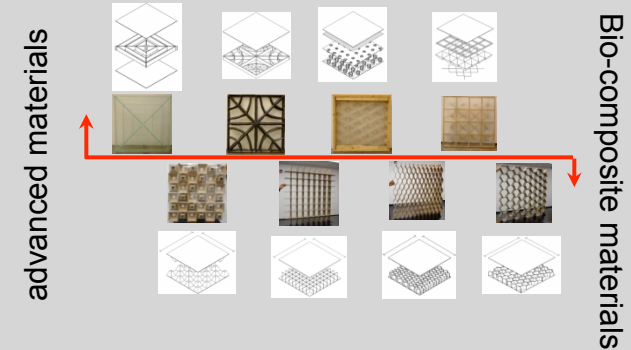
various licenses will become available as product lines are developed for market.

Expected timeline for outside parties

1 year

Contact person at Office of Tech Transfer

Matthew Bell msbell@umich.edu ph 734 647-4738



Current Status

- first stage performance testing
- proof of concept completed
- production assembly system innovation
- marketing plan drafted
- new funding initiatives process

Next Steps

Prototype production trials

Performance Testing – Standards compliances

Research grant needs

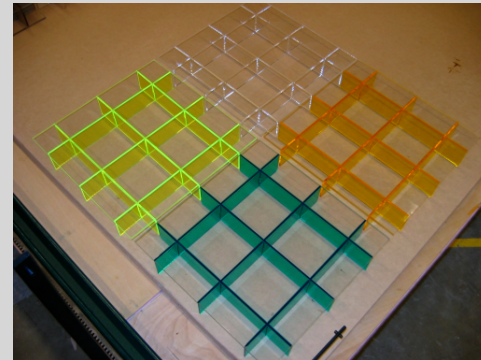
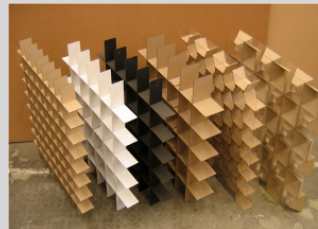
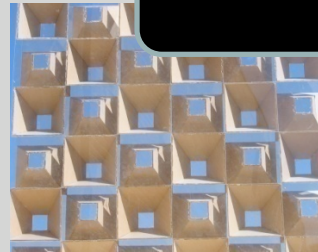
\$500,000 NSF mechanical performance
\$300,000 EPA environmental performance

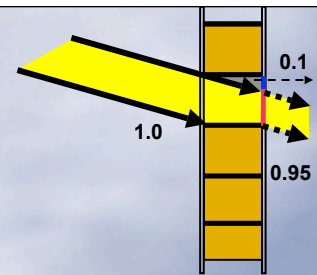
Private funding needs

prototype production trials
small start up facility planning
initial / trial products

Year 1: \$500,000
Year 2: \$1,500,000
Year 3: \$1,500,000
Year 4: \$500,000

Product Line

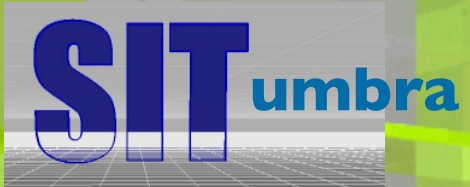




sustainable facade systems

exciting new building skins

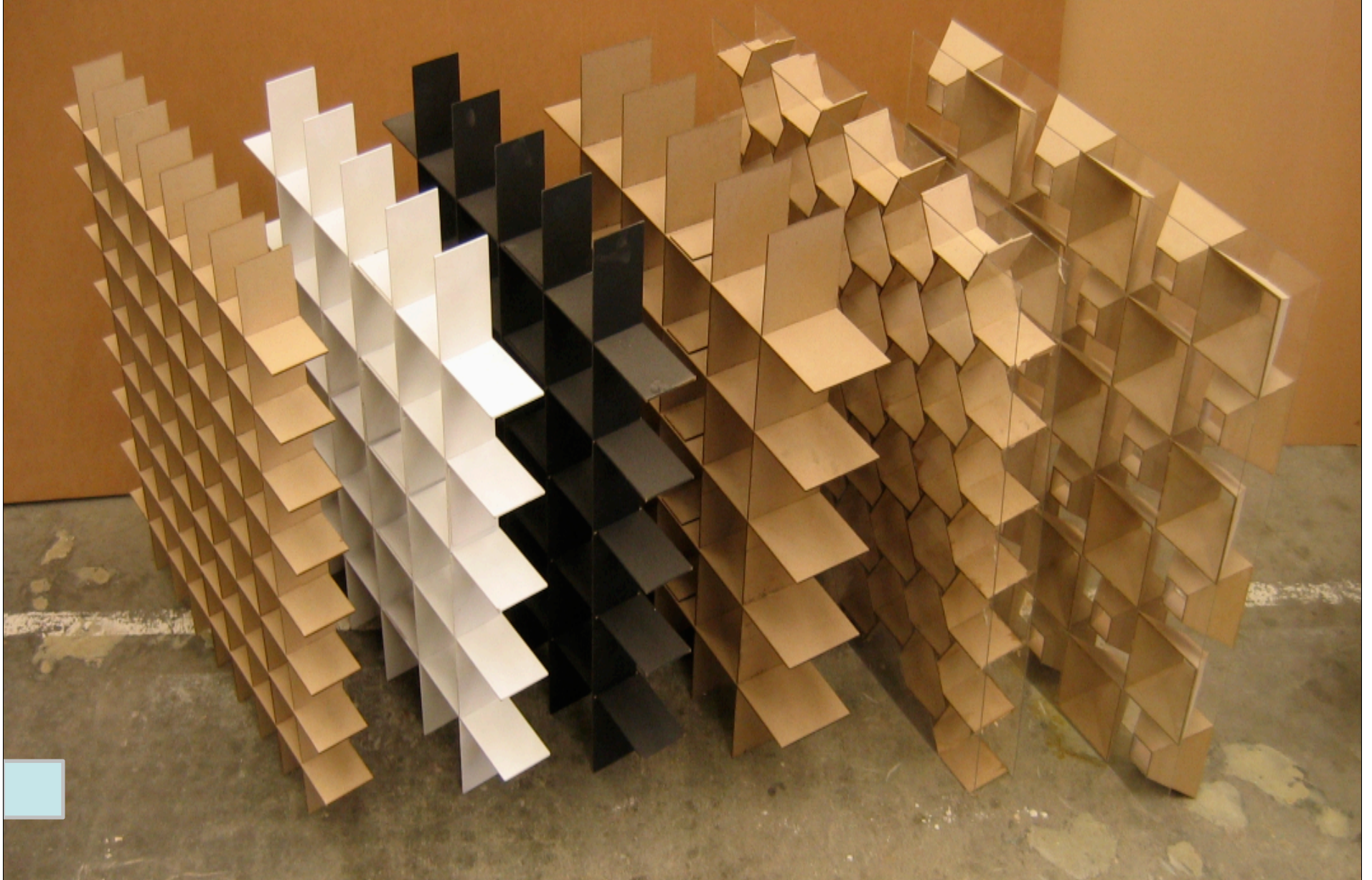
Harry Giles hgiles@umich.edu 734 647 2360



Future concepts for building façade systems



Product Line - Typologies, Materials, Color



Bio-composites for the building industry

Strawboard



Plant: Winter Wheat

Family: Poaceae

Yield: 18 acres of wheat straw can build a 1,760 sf house. It takes the equivalent of one acre of clear cut forest to build the same house.

Maintenance: Minimal insecticides, herbicides, pesticides and tillage required in North America

Composition: Grain (used in food) and stalk (straw used in panels)

Process: Strawboard is made from wheat or rice straw. After harvesting the wheat grain, the straw is a byproduct which causes an environmental disposal problem. Strawboard panels are made of solid core, compressed wheat or rice straw byproduct. High pressure and temperature force the straw to form panels.

Kenaf

Genus: Hibiscus

Species: Cannabinus L.

Yield: 2.43- 4.05 tons / hectare

Growth Period: 12 – 14 feet in 4 – 5 months

Maintenance: Does not require extensive herbicides, and can be grown in cotton and tobacco fields

Range: Kenaf is African in origin; it requires an additional 60-90 days of frost free conditions to reach the point of germination

Composition: 60% core (harder and larger portion) & 40% bast (paper use)

Climate: Throughout the world both in tropical and temperate area; currently grown in Texas, Mississippi, Georgia

Process: The two fibers (core & bast) are cut, shredded and run through an extrusion process. Kenaf can be processed in more than 35,000 tons annually.

