Emerging Technology Investment Opportunities: Sustainable Facade Systems

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Green Buildings - Materials and Applied Technologies
Background - research projects

- 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

New commercialization projects
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

What is the problem?
Strategy:
- Reduce building energy consumption
- Implement passive solar design

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

**S**tructurally **I**ntegrated **T**ransparent Passive Solar Façade System

A building envelope solution
**Structurally Integrated Transparent Passive Solar Façade System**

Focus project technology
Relevant applications

- customizable structural window and wall system
- multiple material and design specifications
- improved building energy performance
- integrated structural shading
- energy efficient façade system
- seasonal passive energy transfer
- agricultural based materials
- large number of variant possibilities
- new architectural aesthetic
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

Energy performance characteristics

- Traditional shading
- SITumbra energy
- Cell Size Design
- Arizona
- Double Glazing
- SITumbra

Life Cycle Analysis
- Double Glazing
- SITumbra

Building Energy Optimized
- Elec
- Gas

Energy load energy analysis
Solution prototyping

- Parametric shading optimization
- Automated manufacturing
- Core and skin detail
- Installation trials
- Thermal imaging
- Thermal testing

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 lightweight window systems to improve energy performance

**Structural**
- Flooring – transparent flooring in special situations
- 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

A new company startup is expected to achieve $200 million in profits by year 10.
<table>
<thead>
<tr>
<th>Customer Needs</th>
<th>Standard glazing</th>
<th>SITumbra</th>
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</thead>
<tbody>
<tr>
<td>Energy Efficiency</td>
<td>Requires double and triple glazing</td>
<td>System inherently double glazed</td>
</tr>
<tr>
<td></td>
<td>- added low e coatings</td>
<td>- no thermal bridge,</td>
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<tr>
<td></td>
<td>- thermal breaks to mullions.</td>
<td>- no low e coatings</td>
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<tr>
<td></td>
<td></td>
<td>and more efficient</td>
</tr>
<tr>
<td>Solar Performance</td>
<td>Low</td>
<td>High</td>
</tr>
<tr>
<td></td>
<td>- requires low e coatings</td>
<td>- variable passive response</td>
</tr>
<tr>
<td></td>
<td>- inefficient in winter</td>
<td>- shading limits summer heat gains</td>
</tr>
<tr>
<td>Safety</td>
<td>Requires laminated / tempered glass</td>
<td>Inherent impact resistance</td>
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- 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
Competitive landscape – complex multi-variable
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  mssbell@umich.edu  ph  734 647-4738
Current Status
- first stage performance testing
- proof of concept competed
- 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
  Year 1: $500,000
  Year 2: $1,500,000
- small start up facility planning
  Year 3: $1,500,000
- initial / trial products
  Year 4: $500,000

Next steps
Thank you!

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.