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2007 Study of United States ● LEED Accredited Professionals on the Subject of Smart Glass

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Smart Glass

Materials that visibly change their light-control properties in response to a stimulus

MAJOR TYPES

Passive

- Photochromic
- Thermochromic

Active

- Electrochromic (EC)
- Liquid Crystal (LC)
- Suspended Particle Device (SPD)

Differentiating Characteristics

- Transmission: light/glare/heat
- Tuning: Binary vs. multiple states
- Switching: speed, consistency
- Substrates: glass only vs. glass or polycarbonate
- Panels: flat vs. flat or curved
- No stimulus: clear vs. opaque
- Voltage: AC vs. DC (actives only)
- Format size: large vs. small

Sustainable Architectural Design

- The movement to “Go Green”
- Sustainable development (U.N. World Commission on Environment and Development)
 - “Development is sustainable when it meets the needs of the present without compromising the ability of future generations to meet theirs.”
- Energy consumed by US buildings (US DOE)
 - 2006: 39,139 trillion Btu
 - Buildings’ share of total energy consumed:
 - 2006: 39.3%
 - 1973: 32.3%
- Emerging perspective: holistic view of building performance

Smart Glass and Sustainable Architectural Design

- Potential Advantages of Smart Glass
 - Broad-based integration:
 - Windows, doors, skylights, light pipes, partitions
 - Greater control over light, glare and heat
 - Improved energy efficiency
 - Optimized building performance via integration with building intelligence systems
 - Daylighting – improved occupant well-being and productivity
 - Lower lifetime costs of buildings
 - Positive environmental impact

Overview of the Study

- Population: U.S. LEED Accredited Professionals (Practice area: "Architect")
 - United States Green Building Council's *Leadership in Energy and Environmental Design (LEED) Green Building Rating System*
 - Accredits professionals involved in the design and operation of buildings
- Online Survey
 - February 2007 communication to population: 4,401
 - Completed surveys: 455
 - Response rate: 10.3%

Respondent Profile

- 84.0% employed by an architectural, design or engineering firm
- 53.0% are licensed architects
- Project Activity - Past 12 months:
 - COMMERCIAL
 - 72.8% worked on 1+ projects
 - 53.8% evaluated, recommended or specified glazing
 - RESIDENTIAL
 - 35.2% worked on 1+ projects
 - 20.4% evaluated, recommended or specified glazing

Sustainable Architectural Design: Activity and Attitudes

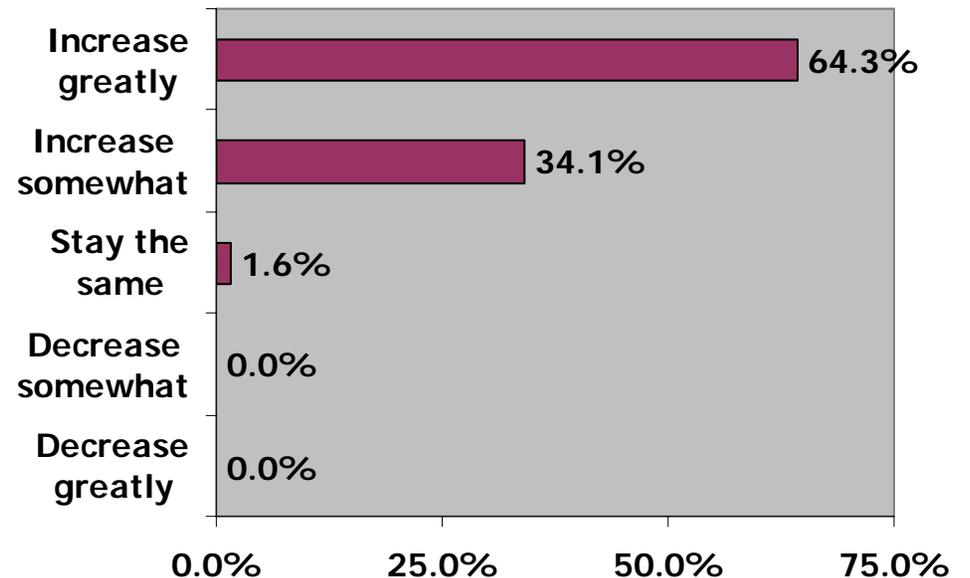
% OF PROJECTS THAT INVOLVE SUSTAINBLE DESIGN

	<u>Commercial</u>	<u>Residential</u>
Median	25.0%	25.0%

Leading Drivers:

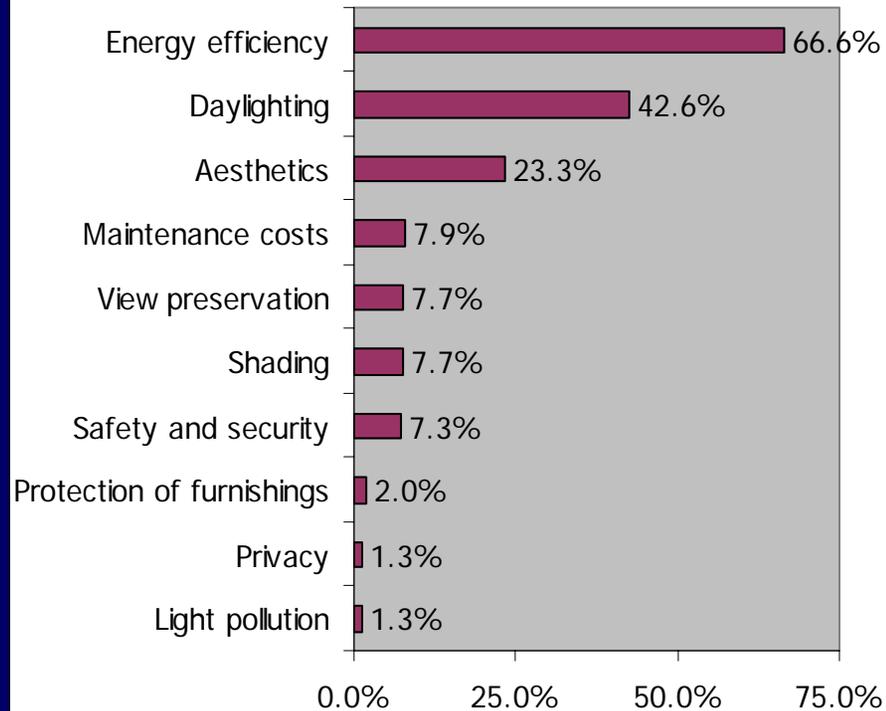
- Potential for energy savings: 60.9%
- Client demand for sustainability: 47.5%
- Lower lifetime operating costs: 34.5%
- Advances in sustainable materials: 20.2%

Expected Change in % of Architectural Projects That Are Sustainable: Next 5 Years

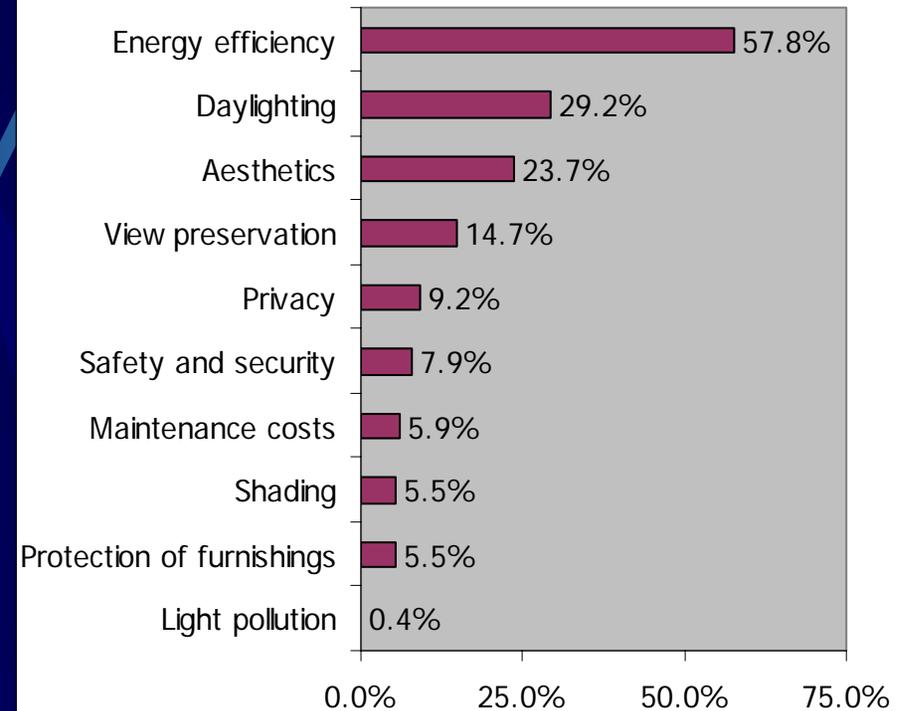


Importance of Items

Importance: COMMERCIAL Glazing



Importance: RESIDENTIAL Glazing



Additional Findings

- 11.5% Are very satisfied with the current offering of windows, blinds, shades and curtains to address buildings' light-control needs.
- 78.3% Believe the importance of glazing for sustainable design will increase over the next 5 years.
- 79.2% Believe demand for laminated glass is increasing.
- 89.6% Believe demand for glazing is increasing.
- 91.6% Believe the price per ft² of glazing is increasing.
- 95.5% Believe demand for solar control glazing is increasing.
- 97.3% Believe glazing plays an important role in sustainable design.

Smart Glass: Awareness and Involvement

- 81.5% aware of smart glass
- Individual/firm ever evaluated, recommended or specified smart glass:
 - 6.6% for 1+ COMMERCIAL projects
 - 2.0% for 1+ RESIDENTIAL projects

Smart Glass: Most Desired Characteristics and Attributes

- Energy efficiency
- Durability
- Integration w/other coatings (e.g. Low-e)
- Glare reduction
- Consistent-looking tint regardless of window size
- Light-control to any point between dark and clear states
- Blockage of >99% of ultraviolet (UV) light
- Fast switching speed
- Variable solar heat gain control

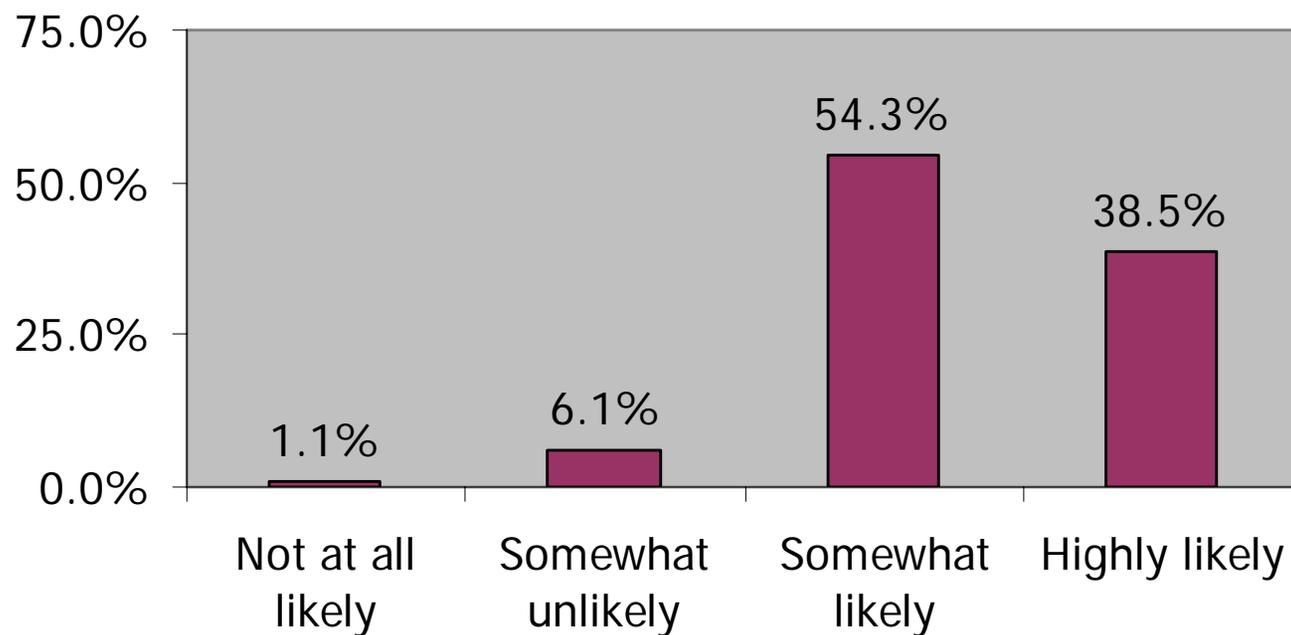
Smart Glass Size and Pricing

- Desired maximum dimensions suppliers should offer (median):
 - Height: 10 ft
 - Width: 6 ft
- Maximum price clients expected to be willing to pay:
 - Commercial
 - \$50 per ft² (median)
 - 25% willing to pay \$75 or more per ft²
 - Maximum: \$200 per ft²
 - Residential
 - \$50 per ft² (median)
 - 15% willing to pay \$75 or more per ft²
 - Maximum: \$175 per ft²

The Outlook for Smart Glass

Likelihood to Recommend or Specify Smart Glass for a Project

(Assumes Reasonable Price and Meeting of Specifications)



Summary

- Growing movement toward sustainable (i.e. “green”) architectural design
- Proportion of architectural projects that are sustainable expected to increase over next 5 years
- Mixed levels of satisfaction with the current offerings of windows, blinds, curtains and shades as they pertain to a building’s light-control needs
- Importance of glazings for sustainable design expected to grow over the next 5 years

Summary (cont'd.)

- Smart glass offers many advantages to support sustainable design
- While awareness levels of smart glass are high, involvement levels have been low to date
- Desired characteristics and attributes of smart glass include energy efficiency, durability and integration with other coatings and films
- The outlook for architectural smart glass is extraordinarily promising