KINESTRAL

2017 North American Smart Glass New Product Innovation Award

FROST & SULLIVAN

2017 BEST PRACTICES AWARD

NORTH AMERICAN SMART GLASS
NEW PRODUCT INNOVATION AWARD

Contents

Background and Company Performance

Industry Challenges

Natural light, despite being one of the most desired features in architectural designs, also leads to negative effects such as aggregation of heat, sun-damaged interiors, and privacy concerns. Though the industry has gradually transitioned from curtains and blinds towards smart technology to address such issues, there are still unmet market needs.

Aside from traditional energy efficiency options, such as insulation and double-paned glass fittings, newer technologies such as electrochromic (EC), thermochromic, and polymer dispersed liquid crystal (PDLC) glass have greatly accelerated developments in natural light management systems. However, their adoption is influenced by their respective shortcomings. For example, while thermochromic technology is effective during summers, it performs poorly with regards to retaining the solar heat gain during the winter. PDLC, on the other hand, has been widely applied to interior applications but its adoption in exterior installations with larger surface areas, such as facades, has not been very encouraging due to issues of increased solar heat gain.

Another key limitation in all corresponding technologies is their inability to accommodate dynamic control and ease of operational features. These technical issues have had a substantial unfavorable impact on the adoption prospects of smart glass technology. Hence, the need to develop smart glass with advanced natural light management features and energy efficiency functionalities is of utmost importance to the building industry.

New Product Attributes and Customer Impact

Matched to Needs

Kinestral Technologies, established in 2010, has developed advances in material science, device physics, and cloud software with applications in smart glass tinting technology that effectively address the aforementioned unmet industry needs. Its flagship product, Halio, has introduced enhanced natural light management properties, such as the ability to attain a uniform tint that can be adjusted to the user's preference history and weather conditions.

With its intuitive user interface, Halio gives the user more dynamic control over natural light. These include the ability to use voice commands and the flexibility to tint panes independently or in groups. This is compelling for both interior (e.g., conference rooms) and exterior applications (windows and skylights), as it provides the ability to reduce HVAC loads and the dependence on internal lighting. Halio also offers increased opportunities that facilitate energy savings by neutralizing the negative aspects of heat and glare from natural light. This enhances the control over the building's thermal management, which will promote the development of energy efficient and green buildings.

Halio was designed to be a complete smart window system that leverages industry standards to ensure interoperability with popular cloud-based devices as well as with building management and home automation systems without the need of any additional equipment or user interfaces. This feature is a highlight for Halio because competing solutions typically require additional components to facilitate their integration with other automation systems.

(Halio for Privacy - *Image courtesy of Kinestral Technologies*)

Reliability

Halio features a patented microcircuit design that constantly receives closed loop feedback from the glass during switching cycles, ensuring optimum power levels for faster switching. A backup power system has been integrated with Halio to perform peak shaving and to deliver the additional power required during transitions. The backup power and the closed loop feedback mechanism assures the longevity and reliable operation of Halio, even during a power outage, while facilitating energy savings.

Halio is also equipped with bank-level security provisions, as communication between systems is encrypted with transport layer security (TLS). User access and control devices for a building's Halio system are authenticated with a device certificate to provide the highest level of security.

Halio has facilitated integration with leading cloud-based weather data sources, including IBM's The Weather Company. Through its patented distributed device network technology, Halio is able to access weather conditions such as cloud cover and solar radiation in real time, and then send prescriptive instructions to the Halio system in a building. This technology allows Halio to leverage the intelligence of the cloud, providing hassle-free reliable weather data, enabling Halio to run independently.

Halio will play a key role in promoting the zero energy building trends by facilitating the utilization of smart glass solutions. Its adoption in zero energy buildings showcases its reliability for employing smart glass as a key structural component while also reducing the use of building materials, such as shading devices for the building constructions.

Quality

Halio differs from first generation electrochromic technologies in its rapid tinting speed, uniform tint transition, tint color, and intuitive user control. The product's ability to attain a uniform tint across larger surface areas without any curtain or iris effect highlights one of the many quality features of the product.

The quality of Halio's solution can also be seen in its capacity to block up to 99.9% of visible light, thus providing an increased level of privacy. The tint level determines how much light is blocked and can be controlled from zero tint to fully tinted, giving users complete control over their ambient working environments. This wide flexibility in tinting range offered by Halio produces many shading effects which architects can effectively utilize in designing interiors and exteriors that help enhance the aesthetics of the building.

To reduce installation and support costs, Halio uses mobile device applications for auto-configuring, commissioning, and troubleshooting during installation. An app is also used to adjust settings, such as the artificial lighting settings inside the building in accordance to Halio's tint settings. With its intelligent architecture and system integration expertise, Kinestral is planning to upgrade the app to facilitate total light control by integrating the natural and artificial light settings.

The uniform switching speed and the options of choosing intermediate states between clear and dark tints will favor Halio's adoption in the transportation industry in the future, such as in trains and avionics. Halio's product quality will help enhance the occupants' experience by varying the tint according to their lighting and comfort preferences. By delivering optimum performance exceeding 50,000 switching cycles, Halio has surpassed the American Society for Testing and Materials (ASTM) test standards cycle count—an indicator of its product quality.

To further augment these quality features, Kinestral has integrated Amazon's Alexa voice-activated technology into its Halio product. To facilitate an enhanced user experience, Kinestral has been actively working with Amazon to expand and optimize the Alexa speech engine library to recognize natural speech. Kinestral is also working to add other voice assistants. Through this ongoing work for enhanced integration, Halio will continue to deliver intuitive, voice activated features.

Positioning

Halio's ease of installation and ability to suit both indoor (interior partitions) and outdoor applications (building facade) has greatly increased its adoption prospects and favorably positioned it into other commercial segments, such as military facilities, greenhouses, laboratories, and healthcare facilities.

Halio's ability to provide a uniform tint throughout its panes has enriched its aesthetic value and has been a key factor that has attracted wide recognition from many segments, especially the healthcare segment. By providing patient privacy and acting as a hygienic

alternate to curtains, Halio is positioning itself to gain an upper hand in this segment by providing a healthy daylight and contamination–free observation environment.

Halio smart glass is a versatile construction material as it can be laminated onto any carrier glass that meets an architect's or customer's aesthetic preference. This customization flexibility has positioned Kinestral to attract a large customer base in the long term.

Halio's functions can be fully optimized during all seasons. Unlike other natural light management solutions, Halio can minimize heat gain in places with sunny weather patterns and maximize heat gain in cold and snowy places. This has positioned Halio as an advanced natural light management system that can be effectively customized for any location specifications.

Design

Kinestral has been granted 24 patents and another 42 are pending. Unlike its competitors, whose tint typically appears in an unappealing bluish or greenish shade, Halio has been designed with a default shade that is similar to the color of the dusk sky to give it a more natural appearance. Halio also comes with a backup power system that is wirelessly connected to all the panes in the building. Through this robust and secure wireless interface, panels can be programmed or manually controlled to retain a clear or tinted state, even in the event of power outages.

Every Halio window is assigned an individual Internet address, which can be validated and programmed exclusively according to customer needs. Because each window has a dedicated transmission control protocol (TCP) and internet protocol (IP) thread, Halio is equipped with functions like the ability to pause the transition mid-process, when the desired tint is reached. The cloud service application makes Halio self-learning and "smarter" over time, enabling it to adapt and respond to users' needs.
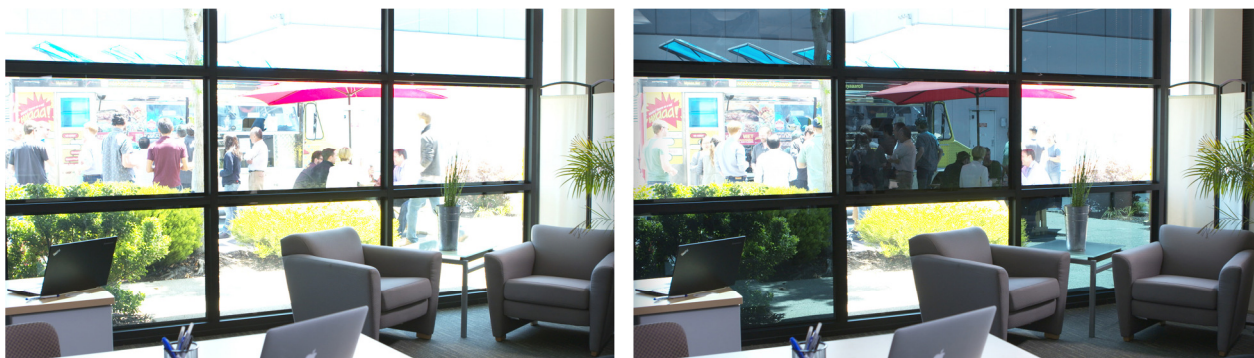
(Halio Enables True Customization - *Image courtesy of Kinestral Technologies*)

Halio also helps architects meet green and wellness building standards, such as the WELL Building Standard® and LEED, as it reduces energy usage by up to 40%. With its design capabilities, Halio has positioned itself as a strong contender in the market and positioned

Kinestral as a company that is helping increase the overall adoption of active smart glass technologies.

Brand Equity

Kinestral Technologies has developed strategic approaches to building its brand equity by forging associations with larger companies in order to gain recognition and enhance its client base through business expansion.

Forging associations with larger corporations has been achieved through Kinestral's strategic partnership with Asahi Glass Co (AGC), one of the global leaders in glass manufacturing. This association helped Kinestral Technologies accelerate Halio's market entry and facilitate its market penetration. The partnership gives Kinestral Technology a competitive advantage over its peers, helping the company gain a high market presence within the smart glass industry—especially in the Asia-Pacific region.

Kinestral's partnership with G-Tech Optoelectronics Corporation (GTOC), a subsidiary of the Foxconn Technology Group, is enabling the mass scale manufacturing of Halio in Taiwan. Through the global partnerships, Kinestral is strengthening its brand equity by achieving wide recognition through product and performance excellence with technical associations and end users, rather than through brand promotion.

Conclusion

With the need for energy efficiency gaining widespread attention, it is imperative that buildings implement the necessary measures within their structures that result in energy savings. With glass being one of the most utilized products in buildings, Halio provides architects and building owners with more opportunities for enhanced energy conservation.

Kinestral Technologies has developed Halio, a smart glass product based on the company's patented smart glass technologies. Halio provides an integrated natural light management system that uses a futuristic electrochromic technique, which offers competitive differentiation through features such as the color of its tint, transition speed of tint, and tint uniformity. These features directly address the challenges the glass industry has been facing. The product's flexibility and ability to be customized for various application give building occupants increased control over sunlight and heat gain irrespective of the location topology. Additionally, the partnerships formed by Kinestral have been very successful and strategic, making it a strong contender in the smart glass market. Because of its strong overall performance, Kinestral Technologies is recognized with Frost & Sullivan's 2017 New Product Innovation Award.

Significance of New Product Innovation

Ultimately, growth in any organization depends upon continually introducing new products to the market and successfully commercializing those products. For these dual goals to occur, a company must be best-in-class in three key areas: understanding demand, nurturing the brand, and differentiating from the competition.

Understanding New Product Innovation

Innovation is about finding a productive outlet for creativity—for consistently translating ideas into high-quality products that have a profound impact on the customer.

Key Benchmarking Criteria

For the New Product Innovation Award, Frost & Sullivan analysts independently evaluated two key factors—New Product Attributes and Customer Impact—according to the criteria identified below.

New Product Attributes

Criterion 1: Match to Needs
Requirement: Customer needs directly influence and inspire the product's design and positioning.

Criterion 2: Reliability
Requirement: The product consistently meets or exceeds customer expectations for consistent performance during its entire life cycle.

Criterion 3: Quality
Requirement: Product offers best-in-class quality, with a full complement of features and functionalities.

Criterion 4: Positioning
Requirement: The product serves a unique, unmet need that competitors cannot easily replicate.

Criterion 5: Design
Requirement: The product features an innovative design, enhancing both visual appeal and ease of use.

Customer Impact

Criterion 1: Price/Performance Value
Requirement: Products or services offer the best value for the price, compared to similar offerings in the market.

Criterion 2: Customer Purchase Experience
Requirement: Customers feel they are buying the most optimal solution that addresses both their unique needs and their unique constraints.

Criterion 3: Customer Ownership Experience
Requirement: Customers are proud to own the company's product or service and have a positive experience throughout the life of the product or service.

Criterion 4: Customer Service Experience
Requirement: Customer service is accessible, fast, stress-free, and of high quality.

Criterion 5: Brand Equity
Requirement: Customers have a positive view of the brand and exhibit high brand loyalty.

Best Practices Recognition: 10 Steps to Researching, Identifying, and Recognizing Best Practices

Frost & Sullivan analysts follow a 10-step process to evaluate Award candidates and assess their fit with select best practice criteria. The reputation and integrity of the Awards are based on close adherence to this process.

STEP		OBJECTIVE	KEY ACTIVITIES	OUTPUT
1	**Monitor, target, and screen**	Identify Award recipient candidates from around the globe	• Conduct in-depth industry research • Identify emerging sectors • Scan multiple geographies	Pipeline of candidates who potentially meet all best-practice criteria
2	**Perform 360-degree research**	Perform comprehensive, 360-degree research on all candidates in the pipeline	• Interview thought leaders and industry practitioners • Assess candidates' fit with best-practice criteria • Rank all candidates	Matrix positioning of all candidates' performance relative to one another
3	**Invite thought leadership in best practices**	Perform in-depth examination of all candidates	• Confirm best-practice criteria • Examine eligibility of all candidates • Identify any information gaps	Detailed profiles of all ranked candidates
4	**Initiate research director review**	Conduct an unbiased evaluation of all candidate profiles	• Brainstorm ranking options • Invite multiple perspectives on candidates' performance • Update candidate profiles	Final prioritization of all eligible candidates and companion best-practice positioning paper
5	**Assemble panel of industry experts**	Present findings to an expert panel of industry thought leaders	• Share findings • Strengthen cases for candidate eligibility • Prioritize candidates	Refined list of prioritized Award candidates
6	**Conduct global industry review**	Build consensus on Award candidates' eligibility	• Hold global team meeting to review all candidates • Pressure-test fit with criteria • Confirm inclusion of all eligible candidates	Final list of eligible Award candidates, representing success stories worldwide
7	**Perform quality check**	Develop official Award consideration materials	• Perform final performance benchmarking activities • Write nominations • Perform quality review	High-quality, accurate, and creative presentation of nominees' successes
8	**Reconnect with panel of industry experts**	Finalize the selection of the best-practice Award recipient	• Review analysis with panel • Build consensus • Select recipient	Decision on which company performs best against all best-practice criteria
9	**Communicate recognition**	Inform Award recipient of Award recognition	• Present Award to the CEO • Inspire the organization for continued success • Celebrate the recipient's performance	Announcement of Award and plan for how recipient can use the Award to enhance the brand
10	**Take strategic action**	Upon licensing, company is able to share Award news with stakeholders and customers	• Coordinate media outreach • Design a marketing plan • Assess Award's role in future strategic planning	Widespread awareness of recipient's Award status among investors, media personnel, and employees

The Intersection between 360-Degree Research and Best Practices Awards

Research Methodology

Frost & Sullivan's 360-degree research methodology represents the analytical rigor of our research process. It offers a 360-degree-view of industry challenges, trends, and issues by integrating all 7 of Frost & Sullivan's research methodologies. Too often companies make important growth decisions based on a narrow understanding of their environment, leading to errors of both omission and commission. Successful growth strategies are founded on a thorough understanding of market, technical, economic, financial, customer, best practices, and demographic analyses. The integration of these research disciplines into the 360-degree research methodology provides an evaluation platform for benchmarking industry participants and for identifying those performing at best-in-class levels.

360-DEGREE RESEARCH: SEEING ORDER IN THE CHAOS

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