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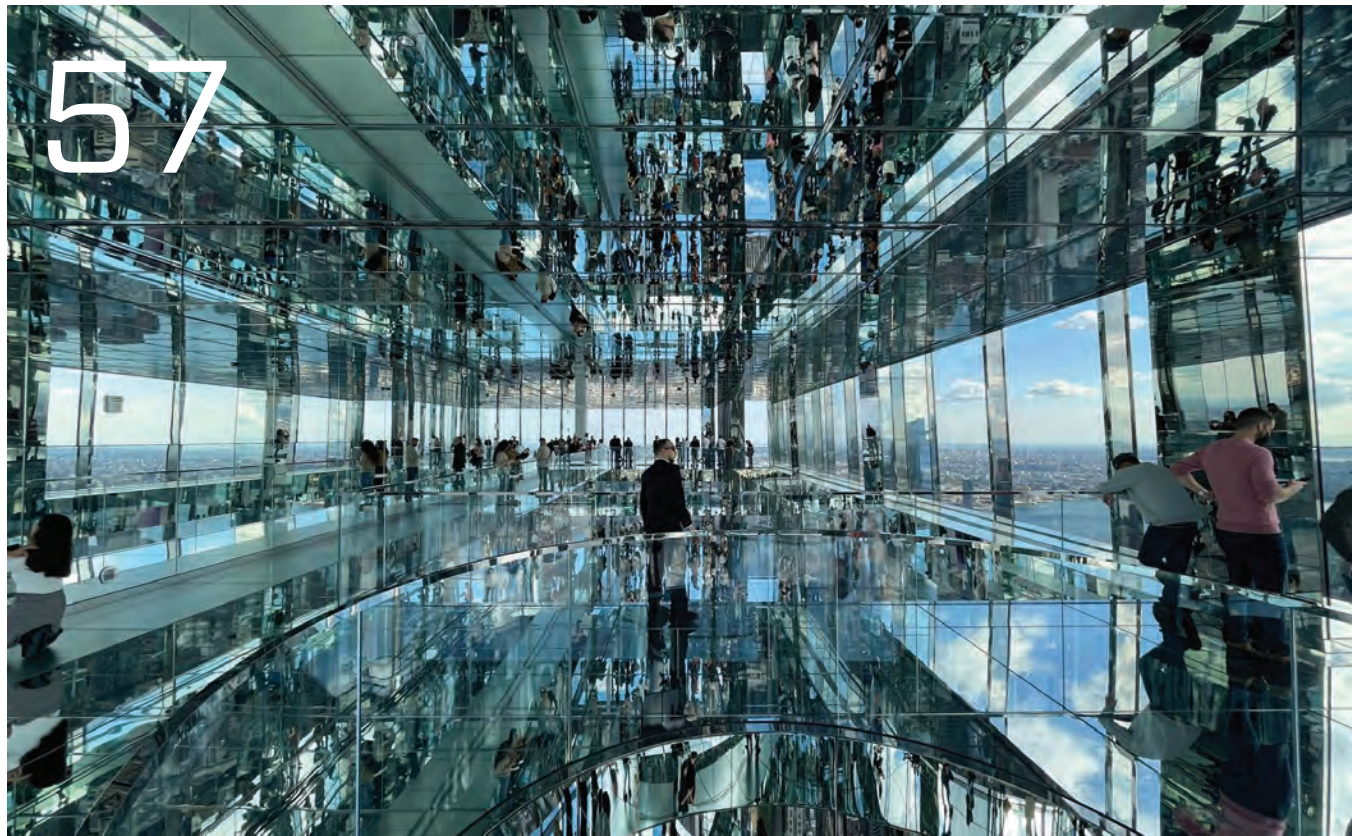


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ON THE COVER:

The glass-clad 25-story Grand Hyatt Nashville, completed in 2020, will serve as host hotel for the National Glass Association's 2022 Building Envelope Contractors Conference and Glass Processing Automation Days, March 27-30. The project was designed by HKS Architects and features high-performance low-e coated insulating glass from Viracon—VRE1-65 and VNE13-63. Physical Security LLC was the glazing contractor. Learn more at GlassMagazine.com. Photo courtesy of Hyatt Hotels Corporation.



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FACTORY VISIT

Tour of Super Sky

By Katy Devlin

PROJECT SHOWCASE



Featured in Glass Magazine Weekly and on GlassMagazine.com. To submit projects or case studies, write Norah Dick, ndick@glass.org. Pictured: Caesars Bacchanal Buffet at Caesars Palace, Las Vegas. The fish station at the buffet is covered with carved, textured face glass panels, fabricated by Pulp Studio, that are backed by a mirror with a 4-inch gap

between them to convey glass bricks reminiscent of ice caves. Photo by Caesars Entertainment

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The Indicators I'm Tracking

In presenting 2022 forecasts, leading construction economists expressed reason for optimism, pointing to strong demand and healthy backlogs. However, economists also warned of an increased level of uncertainty, due to the unknowns related to supply chain, material costs, labor, the state of the pandemic, geo-political tensions and more.

How can glass companies make smart planning decisions when faced with such an unusually cloudy forecast?

I'm neither an economist nor a forecaster. However, there are a few key market indicators I've been tracking in recent months in an effort to see through those forecast clouds.

1. Port delays

WHAT TO TRACK: MONTHLY PORT CONGESTION DATA FROM THE BTS

Supply chain delays have been a major concern for North American glass and glazing companies. Some of those delays can be traced right to overloaded ports, which have struggled in 2021 and 2022 to keep up with record levels of imports while facing pandemic-related labor shortages. Consider, during the first 11 months of the year, the value of U.S. international freight increased by 22.2 percent year-over-year, according to the Bureau of Transportation Statistics.

The BTS provides information on how many cargo ships are coming into U.S. ports, how long those ships are waiting to dock and how long it takes for cargo to leave the ports.

2. Freight costs

WHAT TO TRACK: FBX GLOBAL CONTAINER INDEX FROM FREIGHTOS

Industry companies are also grappling with skyrocketing shipping costs. Global shipping costs for 40-foot containers increased 122 percent in 2021,

according to the FBX Global Container Index from Freightos Ltd.

In November, Freightos' head of research, Judah Levine, said the "ocean peak season seems to have come to an end." However, he continued, "prices are likely to be kept well above the norm by port congestion, low inventories and still-elevated consumer demand."

3. Construction material costs

WHAT TO TRACK: PRODUCER PRICE INDEX FOR CONSTRUCTION MATERIALS FROM THE BLS

Construction material costs increased by 26.6 percent year-over-year in 2021, according to the Producer Price Index from the Bureau of Labor Statistics. While the sector did see a slight decline in costs in December, cost increases still exceeded the rise in contractors' bid prices, which increased 12.4 percent during the year.

BLS provides a Producer Price Index series for construction materials that looks at 15 products, from plywood to cement to diesel. The industry saw double-digit gains for 13 of the 15 products on this construction

material list in 2021; however, the cost increases began to show signs of slowing in the final three months of the year.

4. Construction employment

WHAT TO TRACK: MONTHLY JOBS REPORT FROM THE DOL

The January Jobs Report from the Department of Labor offered surprisingly strong numbers, despite surging omicron cases across the country. Employers gained 467,000 jobs during the month. Additionally, the BLS revised jobs data sharply upward for December (510,000 new jobs, up from initial reports of just 199,000 new jobs) and November (647,000, up from initial reports of 249,000). The U.S. labor force gained a record 6.665 million jobs in 2021.

Despite the overall growth in jobs, construction employment slipped during January, losing 5,000 jobs. The sector's employment continues to sit 1.3 percent below pre-pandemic levels, according to AGC of America Chief Economist Ken Simonson. "Contractors are struggling to fill positions as potential workers opt out of the labor market or choose other industries," said Simonson in an AGC release. "In addition, soaring materials costs and unpredictable delivery times are delaying projects and holding back employment gains."

Visit [GlassMagazine.com](https://www.glassmagazine.com) for complete 2022 industry forecasts and for additional coverage on the indicators that relate to our industry. ■



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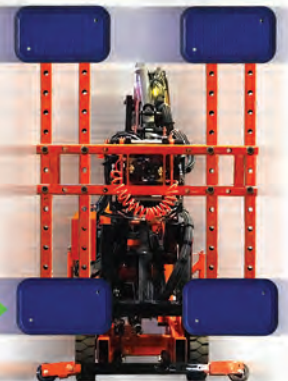
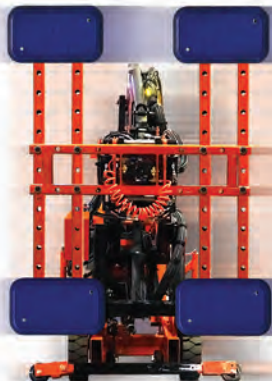
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AND SAFE—IN A
WORD, ESSENTIAL.”

NGA LEADS ARCHITECTURAL GLASS ACTIVITIES FOR THE INTERNATIONAL YEAR OF GLASS

2022 has been designated as the International Year of Glass by the United Nations General Assembly. NGA has supported the worldwide effort since the campaign’s inception and is leading the efforts for architectural glass activities and promotion in the United States.

IYOG will celebrate the essential role glass has in society, serving as a life-changing material in architecture, the environment, healthcare, science, technology and more. The campaign was led by the International Commission on Glass, along with the Community of Glass Associations, of which NGA

is a member, and the International Committee for Museums and Collections of Glass. Urmilla Sowell, NGA’s director of advocacy and technical services, is currently serving on the IYOG 2022 North American Steering Committee.

“It’s our year, and it’s our time to show the world how glass is adaptable, sustainable, energy-efficient, strong, beautiful, and safe—in a word, essential,” said NGA President and CEO Nicole Harris. “I look forward to celebrating the glass and glazing industry with others around the world, and especially here at home.”

The year’s activities officially began with a two-day opening event at the Palace of Nations in Geneva, Switzerland, Feb. 9-11, 2022. The event brought together glass associations from all over the globe, providing connections and conversations to help move the industry forward.

Throughout the year, NGA will promote the solutions glass provides to the built environment and spotlight the glass industry as an exciting and rewarding career to the next generation of workers. ■



NGA PRESIDENT JOINS COUNCIL OF MANUFACTURING ASSOCIATIONS BOARD

Nicole Harris, National Glass Association president & CEO, and two other trade association executives, were appointed to the CMA's Board of Advisers for 2022.

Made up of 260 industry-specific manufacturing associations representing 130,000 companies worldwide, the CMA creates powerful partnerships across the industry and ensures manufacturers have the strongest possible voice.

"I'm honored to join my trade association peers to help articulate manufacturing's key role in our country's economic success," says Harris, who served on a Diversity, Equity and Inclusion (DEI) task group in 2021 under the leadership of CMA past chair, Anne Forristall Luke, president of the U.S Tire Manufacturers Association. "I look forward to helping this year's chair, Philip Bell, president of the Steel Manufacturers Association, pursue his goals for the CMA and NAM."

"Americans are counting on manufacturers to lead our economic recovery, deliver promising career opportunities and solve our global health crises, and the collaboration made possible through the CMA empowers

our entire industry to rise to the challenge," said NAM President and CEO Jay Timmons.

The CMA's mission is focused on bolstering the industry's nationwide grassroots mobilization efforts and improving the competitiveness of manufacturers in the United States. CMA members work with the NAM to unite the manufacturing association community, and the broader business community, around strategies for increased manufacturing job creation, investment and innovation in America.

Harris is a 32-year glass industry veteran and president of the NGA since 2014. Harris, her staff of 30 and NGA member volunteers advocate for the glass and glazing industry and deliver vital products and services to help glass companies succeed, living up to the promise of the 2018 combination of the NGA and the Glass Association of North America (GANA). ■

NGA PRESENTS THE 2021 ANNUAL REPORT

NGA released its 2021 Annual Report, illustrating the value NGA and its volunteers create for the industry. "Last year, we were running on adrenaline and moving into exhaustion over the pandemic," said NGA President & CEO, Nicole Harris. "And still, we pushed forward. This 2021 Annual Report is a record of our industry's innovation and resilience."

The 27-page report is separated into four chapters, each representing the NGA's foundational goals: Educate, Advocate, Promote and Grow. It highlights milestones and achievements from the

association's wide range of activities, including GlassBuild America, the largest annual trade show for the glass and fenestration industries in the Americas; the MyGlassClass.com online education platform; the essential work advocacy and code team; and the NGA's leading industry publications, Glass Magazine and Window + Door. The report also details the efforts of the technical team and volunteer leaders, which released three new and five updated Glass Technical Papers, two new Design Guides, and one new and one updated manual.

View and download the entire annual report at glass.org. ■

2021 MILESTONES, BY THE NUMBERS

\$10.3 billion

in annual sales of NGA member companies

89

Glass Technical Papers, including 8 new or updated in 2021

5,100

attendees from 35 countries at GlassBuild America 2021

115

MyGlassClass.com courses and 3,100 total users

3,454

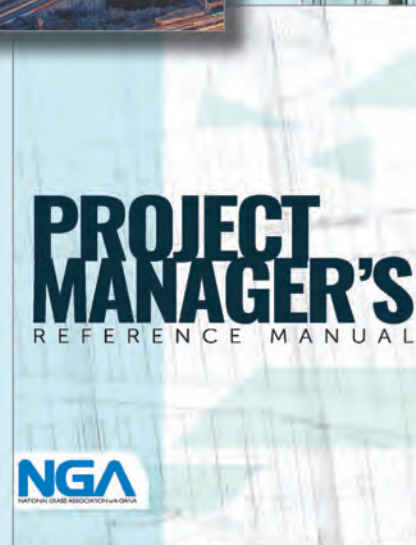
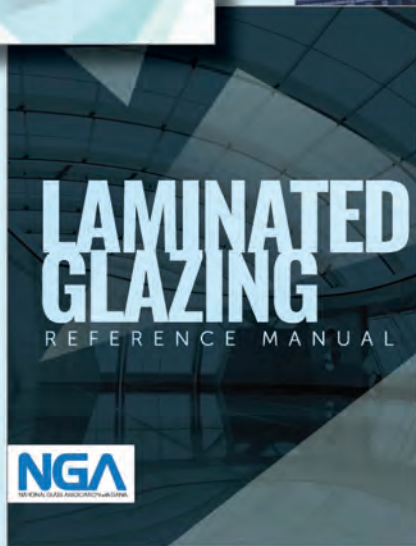
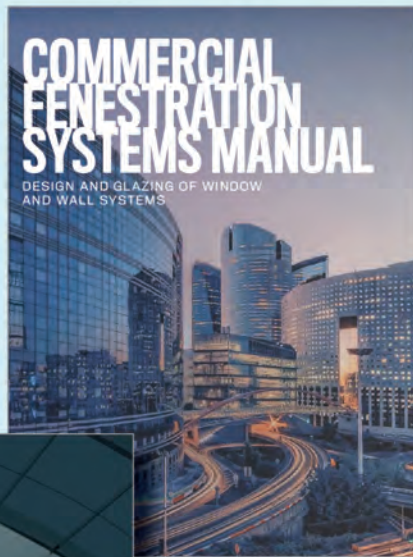
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GLASS INFORMATIONAL BULLETIN

How to Inspect Decorative Glazing

Decorative glass is a versatile product, used primarily due to its aesthetics and ability to add functionality to glazing installations. The important distinction of evaluating if glazing is a decorative product is that the primary purpose for the application is to enhance aesthetics. The use of traditional materials with decorative intent does not alter the applicable standards.

Viewing conditions for blemish detection

Suggested methods for inspection are based on the final installation of the decorative glazing. These may be used as is, or as a starting point to develop an internal inspection standard or an agreed method of inspection with a client. The inspection time for each decorative glazing sample should be limited based on the size of the panel.

Inspection/viewing time

All visual inspections shall be made with 20/20 vision (naked eye or corrected). View decorative glazing products in the vertical position at the distance specified in Table I.

Interior applications

The viewer shall be positioned perpendicular to the glass surface when inspecting in transmitted mode and at an approximately 45-degree angle when viewing in reflected mode (using lighting consistent with the final installed environment).

Table 1: Allowable Blemishes for the Decorative Component

Typical usage is ≤ 8 ft away from observer Viewing Distance is 39 in (1 m)		
	One Side Viewing	Dual Side Viewing
Banding, Smear	Light intensity B	Light intensity B
Corona, Halo, Streak, Spray	Medium intensity C	Medium intensity C
Craters, Fisheyes, Hickey	Not larger than 1/16 in (1.6 mm) and no closer than 2 in (50 mm) on center A	Not larger than 1/16 in (1.6 mm) and no closer than 2 in (50 mm) on center A
Mottle, Opaque Particle, Ghost, Sawtooth	None detectable	None detectable
Opacity	Not applicable	As per Mock-up or Master Sample
Pinholes	Not applicable	Pinholes are permissible
Voids	Voids cannot be larger than 1/16 in (1.6 mm) and no closer than 2 in (50 mm) on center A	Voids cannot be larger than 1/16 in (1.6 mm) and no closer than 2 in (50 mm) on center A
Screen Marks	Light Intensity B	None detectable

A Cluster – Three or more blemishes in a 6-inch diameter circle

B Light intensity – Barely noticeable at 39 inches (1 m)

C Medium intensity – Noticeable at 39 inches (1 m) but not at 10 feet (3 m)

ASTM C1036 is used for glass substrate blemishes. Use ASTM C1172 for laminated glass blemishes.

Note: This table is excerpted from the original table in the full Glass Technical Paper. Refer to the GTP, available at glass.org/store, for definitions of the blemish types noted in Table 1, and for allowable blemishes when typical use is greater than 8 feet from the observer.

Exterior applications and interior lit by natural daylight

The viewer shall be positioned directly in front of the glazing at a consistent angle (+/- 5 degrees) to the glass surface.

Blemishes detected per the prescribed viewing conditions and distance specified

can then be compared to Table I to determine accept/reject decision. Blemishes detected by other viewing conditions and/or distances are not considered rejectable. If any differences exist in results between viewing under external conditions compared to internal conditions, the



GLASS INFORMATIONAL BULLETIN—HOW TO INSPECT DECORATIVE GLAZING

internal viewing results shall be considered the master results and override external viewing results.

Low resolution or blurry image definition is not considered a defect but a result of limits of the file quality or printer capabilities. Review of mock-ups prior to the manufacture of the final product are recommended to manage expectations.

Opaque products

Place diffuse lighting on the same side as the observer (use for one- or two-sided by rotating glass to side two if needed). Situate lighting at approximately 45 degrees and off to the side of the glass panel being viewed. Direct reflection of the light is to be avoided. Follow the inspection procedure.

Translucent products

Face diffuse lighting toward the back wall on the other side of the glass (use for one- or two-sided by rotating glass to side 2 if needed). Situate lighting at approximately 45 degrees and off to the side of the back wall that will be looked at through the glass. Direct reflection of the light is to be avoided. Follow the inspection procedure.

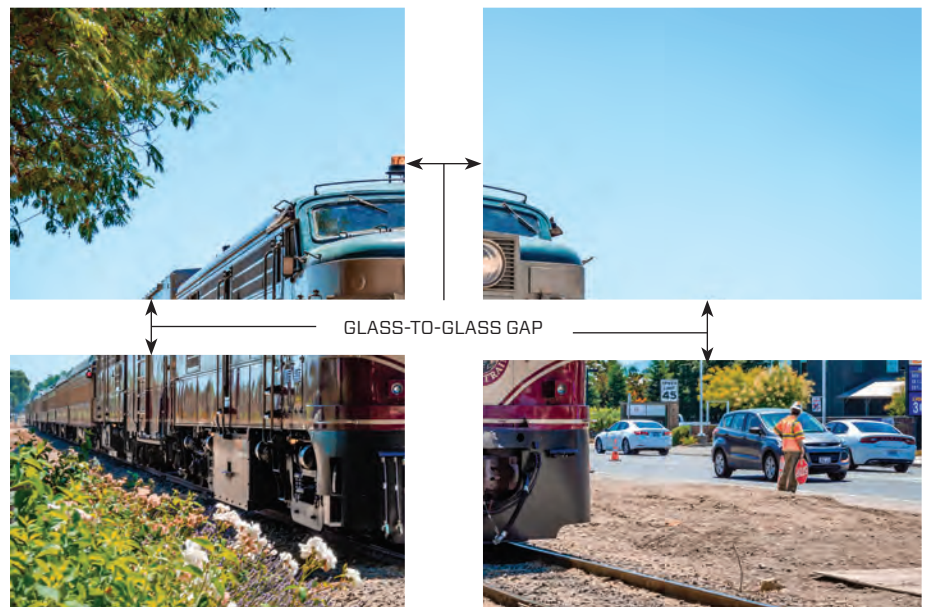
Tiling tolerance

Guidelines for alignment tolerances are listed. Ability to register from process to process may vary. Please contact the manufacturer. ■

Tiling Tolerances

Gap	Two-Sided Tiling—Vertically or Horizontal	Four-Sided Tiling—Vertically or Horizontal
$\frac{1}{8}$ in	$\frac{3}{16}$ in	$\frac{1}{4}$ in
$\frac{3}{16}$ in	$\frac{3}{16}$ in	$\frac{1}{4}$ in
$\frac{1}{4}$ in*	$\frac{1}{8}$ in*	$\frac{1}{4}$ in*
$\frac{5}{16}$ in	$\frac{1}{8}$ in	$\frac{1}{4}$ in
$\frac{3}{8}$ in	$\frac{3}{16}$ in	$\frac{1}{4}$ in
$\frac{7}{16}$ in	$\frac{3}{16}$ in	$\frac{1}{4}$ in
$\frac{1}{2}$ in	$\frac{1}{4}$ in	$\frac{1}{4}$ in

*Recommended minimum gap for tiling images. For glazing tolerances please reference the GANA Glazing Manual.



When tiling images—presenting images across multiple lites of glass—the image should extend across the gap to prevent interruptions in the picture. See the guidelines for alignment tolerances for two- and four-sided tiling in the tables above.

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Bloomberg Reports that CRH Plans to Sell Oldcastle BuildingEnvelope

According to a Dec. 7 breaking news report from Bloomberg, CRH Plc is planning a sale of Oldcastle BuildingEnvelope in a deal that could be worth more than \$3 billion, per “people with knowledge of the matter.” Officials from CRH declined to provide official comment to Bloomberg.

DMC Global to Acquire 60 Percent Controlling Interest in Arcadia Inc.

DMC Global Inc., a diversified

holding company, signed a definitive agreement to acquire a 60 percent controlling interest in privately held Arcadia Inc. for \$282.5 million in cash and DMC stock. Arcadia is a U.S. supplier of architectural building products, which include exterior and interior framing systems for low- and mid-rise commercial buildings.

Arcadia CEO Jim Schladen says, “This is an exciting transaction for Arcadia, its employees and our customers. We look forward to DMC’s support as we expand Arcadia’s capacity and increase

its position in the commercial and high-end residential architectural products markets. I am confident this will be an outstanding partnership that will provide long-term benefits to Arcadia, DMC, and our stakeholders.”

Kevin Longe, DMC’s president and CEO, says, “This is a milestone transaction for DMC and aligns with our strategy of building a diversified portfolio of industry-leading businesses with differentiated products and services. The acquisition of Arcadia will double DMC’s consolidated sales, strengthen our

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gross margins and provide diversification outside our more cyclical energy and industrial infrastructure markets.”

Basco Shower Enclosures Acquires Glassource

Basco Shower Enclosures joined forces with Michigan-based Glassource, a tempered glass and shower door solutions provider. This strategic

partnership expands Basco’s corporate footprint, providing broader regional services and additional product offerings. Furthermore, this acquisition increases Basco’s overall capacity, with a total of three tempering and fabricating locations in Ohio, North Carolina and now Michigan, providing services to the eastern United States.

“The Glassource acquisition is

a great fit for Basco as we are able to improve our speed-to-market capabilities and overall product portfolio,” says George Rohde, Basco’s chairman/CEO. Jim Arnold will remain as president of Glassource

Installed Building Products Acquires Denison Glass & Mirror Inc.

Installed Building Products, an installer of insulation and complementary building products, announced the acquisition of Denison Glass and Mirror Inc. and an affiliated entity, DGM Glass. Established in 1947, Denison is located in Denison, Texas, and primarily serves the Dallas/Fort Worth area.

“With approximately \$20 million of annual revenue, DGM expands our presence to commercial builders within the strong construction markets of Dallas and Fort Worth,” says Jeff Edwards, chairman and chief executive officer. “To date in 2021, we have acquired approximately \$130 million of annual revenues, further surpassing our \$100 million acquired revenue target for this year. Acquisitions remain a key component of our growth strategy and we continue to have a robust pipeline of opportunities across multiple geographies, products and end markets.”

Fenzi Group Announces Acquisition of Advanced Glass Technologies

Fenzi Holdings SPV S.p.A acquired Johnson Matthey’s Advanced Glass Technologies business, a global provider of specialist glass enamels and precious metal pastes supplied mainly to the automotive sector. The acquisition is expected to close in the spring of 2022.

Fenzi Group’s Chief Executive Officer Alessandro Fenzi says, “We are delighted to welcome the AGT organization to the Fenzi Group. AGT leadership in glass enamels for the automotive and industrial sectors fits perfectly with our strategy to be the largest and most complete partner for

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the glass industry worldwide. This partnership brings new, innovative technologies to our global customer base. We believe that AGT's growth will be enhanced under the Fenzi Group."

Aldora to Open a New Location in Newport News, VA

Glass and aluminum systems fabricator Aldora acquired a new 72,000-square-foot fabrication facility located in Newport News, Virginia. The building is already 100 percent under construction. Aldora expects the facility, their seventh location, to be fully operational by July 2022.

Originally, Aldora announced building a new manufacturing facility in Chesterfield, Virginia, but, according to CEO Leon Silverstein, "due to the escalating cost of construction materials and the timing of construction, we are now fortunate in finding an alternative building in

Newport News. This newest facility services an area that has been underserved by the market according to our preliminary research. Our model has been to add locations that will fit strategically into our current geographic coverage."



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UltraGlas, California-based Glass Fabricator, Will Close

UltraGlas, a glass fabricator located in Chatsworth, California, will close, according to reporting in the San Fernando Valley Business Journal. The company is owned by Jane Skeeter, also the chief executive, who founded and has run the business for 50 years.

NSG Group Introduces Renewable Electricity in Poland

NSG UK Enterprises, part of the NSG Group, signed a power purchase agreement with EDP Renewables, the world's fourth largest renewable energy producer, for the renewable electricity generated by a wind farm located in Poland.

John Wilgar, head of procurement at NSG Group, says, "We are delighted to sign our first virtual PPA with our partner EDPR for the majority of our electricity demand in Poland. This helps us to secure

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renewable electricity at predictable costs over the long term in a market with a highly carbon-intensive grid. It is a huge step toward our sustainability objectives in support of our actions on climate change.” It is the first virtual PPA by NSG Group and the first PPA signed by a glass manufacturer in Poland.

Halio Inc. Announces \$100M in Financing Led by SK and Capricorn

Halio, a smart window manufacturer, announced an additional \$100 million in financing led by inside investors SK and Capricorn Investment Group. SK is Korea’s third-largest company. Halio aligns with SK’s focus on Environmental, Social and Governance materials solutions.

“SK recognizes the benefits that Halio Smart Glass brings to our lives, the planet, and its synergy with our investment in ESG,” says Dong Uk Choi, vice president of SK.

Halio develops and commercializes advances in electrochromic technology that maximize natural light while mitigating solar heat and glare. The Halio Solution includes smart glass and a cloud-based AI control system. This system can fulfill architects’ design vision, meet sustainability objectives, and create an immersive daylight experience for occupants, say company officials.

ODL Acquires Glass Company Verre Select

ODL Inc. acquired Verre Select, a specialty glass company in Quebec, Canada. “The addition of Verre Select is the perfect foundation for new growth with two already reputable and trusted brands,” says Dave Klein, president, ODL.

“Today is a very exciting day for the Verre Select team, as we have taken the bold step to protect our future growth by

partnering with ODL, the leading door glass supplier in North America,” says Patrice Lamy, president, Verre Select. “This important partnership positions our organization so we can enhance our product lines, improve our processes and expand our reach right here in Canada and beyond.”

With this acquisition, ODL will absorb Verre Select’s operations and employees, with the Verre Select current organizational structure remaining unchanged.

Deceuninck and AGC Glass Europe Enter into a Strategic Partnership

Deceuninck, specialized in the development and production of PVC and aluminum window and door profiles, and AGC Glass Europe entered into a strategic partnership. The combination resulted in new innovative solutions that enable the integration of Fineo vacuum glass into the PVC and

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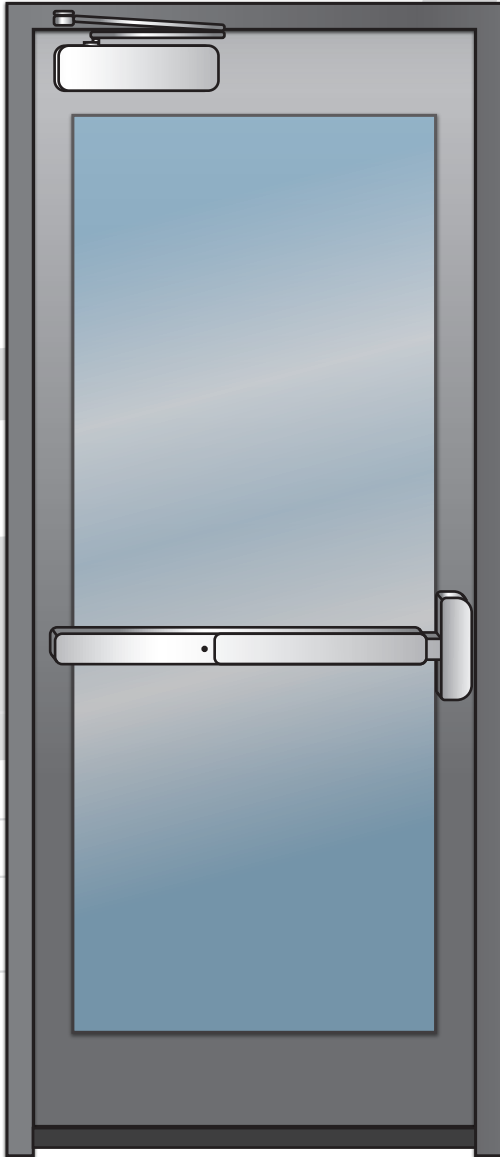
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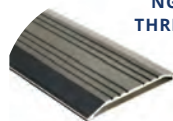
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This way architects, building contractors and owners have access to solutions that meet the ever-stricter requirements in the field of thermal and acoustic performance and light transmission. The first systems solutions will be presented during the Polyclose fair at the stands of both strong brands.

Andersen Corp. Invests in Ubiquitous Energy

Andersen Corp. announced a strategic investment in Ubiquitous Energy, a company in transparent photovoltaic technology that converts light into electricity using semiconductor materials while maintaining visible transparency.

Ubiquitous Energy's UE Power technology is a transparent photovoltaic glass coating that harnesses solar power to generate electricity, while remaining

almost indistinguishable from traditional windows. The technology provides a clear, natural experience, but with renewable energy generation that can be used for self-contained, on-board power and smart home functionality, or to offset energy consumption elsewhere.

It is a complementary solar power asset that works within a portfolio of other renewable technologies for a larger, cumulative effect.

TOP PERSONNEL NEWS



Webb

Fenestration and Glazing Industry Alliance

The Fenestration and Glazing Industry Alliance announced the retirement of industry leader Marg Webb, after 22 years in the glass industry. Webb began her time at the Insulating Glass Manufacturers Association of Canada

in 2000 prior to that organization's transition into the Insulating Glass Manufacturers Alliance, where Webb led as executive director for nearly two decades. She also resigned her post as FGIA's Glass Products and Canadian Industry Affairs Director for a long-deserved retirement.



Lang

GED Integrated Solutions Inc.

GED Integrated Solutions Inc. named Steve Lang CEO and president of the

company, succeeding Bill Weaver, who has held the post since 2008.

Steve Lang joined GED in 1997 as its chief financial officer, working with the original founders of the company. Prior to GED, Lang had been a senior manager at Ernst & Young, where he began his career as a CPA and CMA.

The company also appointed Heather Cullion to the position of vice president of finance. Previously, she served as controller.

Cullion has been with GED for the past fifteen years, starting as an intern and progressing through various positions within the accounting group.



Cornellier

TSI Corp.

TSI Corp. appointed Thomas Cornellier as chief executive officer.

Cornellier joined TSI Corp. in 2009 and has spent the last 12 years serving in multiple capacities including chief financial officer, chief operating officer and chief strategy officer. ■

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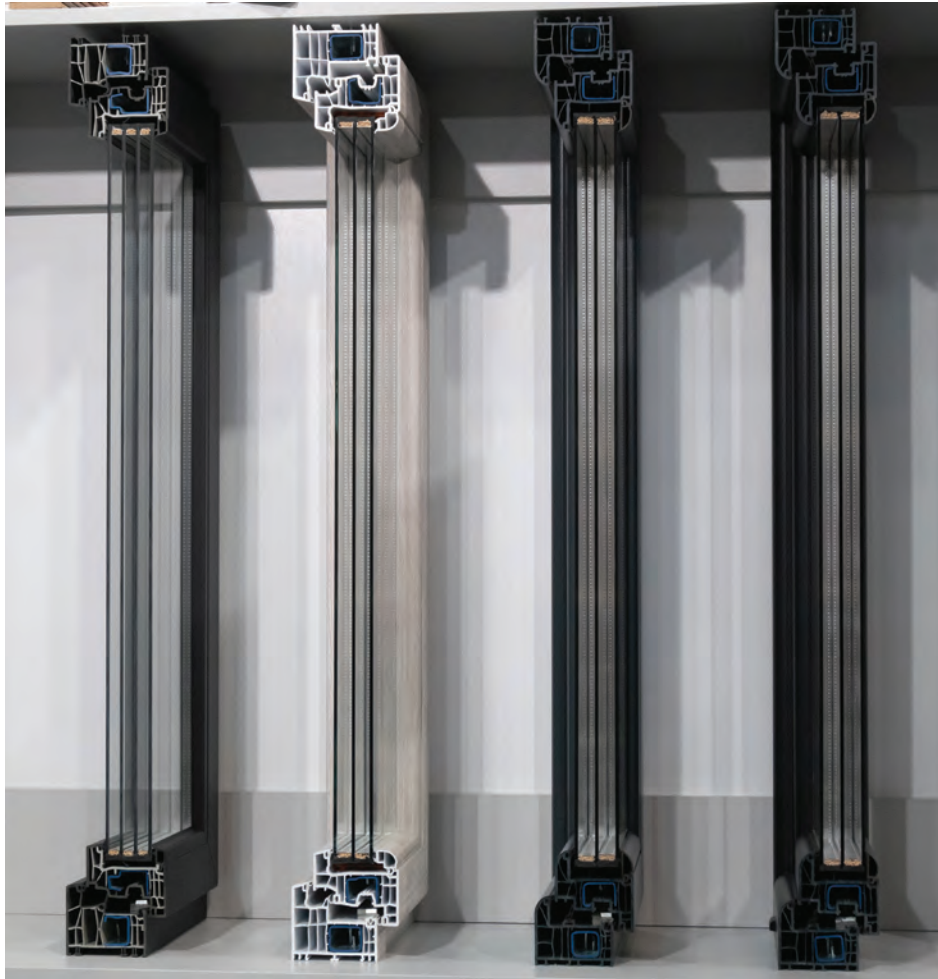
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RESOURCES

Read this article online at GlassMagazine.com for direct links to all resources.

- “Thin Triple Pane Windows: A Market Transformation Strategy for Affordable R5 Windows,” by Stephen Selkowitz, available in the Northwest Energy Efficiency Alliance, Report #E20-310, April 2020.
- Flat Glass Environmental Product Declaration, National Glass Association, ASTM-EPD121, December 2019 (pdf).
- ENERGY STAR® Windows, Doors, and Skylights Version 7.0 Criteria Analysis Report, July 2021 (pdf).
- PNNL prototype buildings.

modifications, weight and more. There are significant efforts underway to ease the transition, whether that is using traditional triple glazing or the newer concept of “thin triples” using a thin glass middle lite. The numerous support initiatives include technical support from Lawrence Berkeley National Laboratory, ongoing field demonstrations across the country by Pacific Northwest National Laboratory, market assessments by Steve Selkowitz and the Northwest Energy Efficiency Alliance, and the new Partnership for Advanced Window Solutions.

The embodied energy question

In this article, I will just address one question that has been raised about embodied energy: Is the energy savings gained by moving from double to triple glazing outweighed by the extra energy

CODE WATCH

TRIPLE GLAZING AND EMBODIED ENERGY

YES, THE JUICE IS WORTH THE SQUEEZE
BY TOM CULP



As both national and local groups look for solutions to address climate change, decarbonize the buildings segment and greatly increase energy efficiency, it is clear that high-performance fenestration has an important role to play. Is this the momentum that is needed to finally make triple glazing go mainstream in colder climates?

There are a number of considerations with moving to triple glazing including cost, manufacturing changes, frame



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used to make the third pane in the first place?

This is a fairly straightforward question to answer, at least in a simplified manner. First, the embodied primary energy associated with manufacturing the added third lite is easily calculated from the National Glass Association industry-wide environmental product declaration for flat glass, ASTM-EPD121. This will vary

based on the thickness of glass, as shown below. Next, this is compared against the corresponding energy savings in a representative building from moving from double glazing to triple glazing, which will vary based on building type and location. The result can be easily understood in terms of the payback time—how long until the extra energy to make the third lite is “paid back” by the energy savings.

Measuring energy impacts

For commercial applications, PNNL has developed prototype building models to assess the energy impacts of different energy efficiency measures and overall advancements in the ASHRAE 90.1 standard. The ASHRAE 90.1 envelope subcommittee uses two of the prototypes to evaluate proposed changes to envelope requirements, including fenestration U-factor and solar heat gain coefficient, SHGC: the medium office model (three-story, 53,600-square-foot floor area, 33 percent window-to-wall-ratio ribbon windows) and the midrise apartment model (four-story, 33,700-square-foot floor area, 20 percent WWR punched openings).

Per the methodology used by ASHRAE 90.1, the average reduction in U-factor and SHGC by moving from double to triple glazing with the same low-emissivity, frame, spacer and gas fill in commercial window wall is 0.05 Btu/hr ft² F and 0.03, respectively. The energy savings are shown for ASHRAE 90.1 and IECC climate zone 6 using Rochester, Minnesota, as the representative city. The embodied energy will depend on the thickness of the middle lite, which can be 6-millimeter in traditional full-width commercial triple glazing, but some fabricators are also exploring a commercial version of “thin triples” with 2.2-millimeter glass as the center lite.

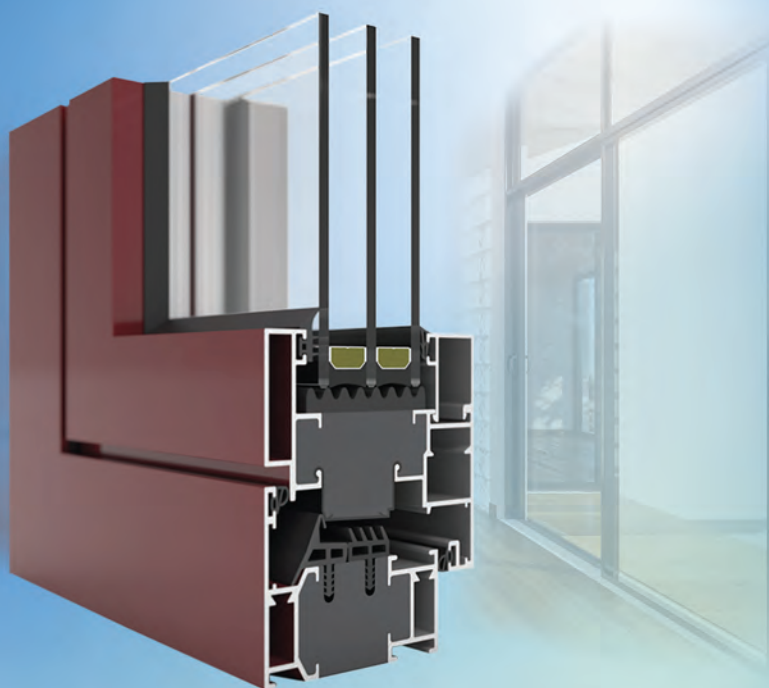
The results

As shown in the table on p. 32, the embodied energy of the third lite is paid back in only nine months to 2.7 years in climate zone 6. The payback in climate zone 5 (including places like Chicago and Lincoln, Nebraska) is three to nine months more. Overall, the payback is a little longer in commercial applications than in residential due to using thicker glass in commercial applications, but it is still very short compared to the lifetime savings.

A clear answer

This analysis is somewhat simplified, just answering the general question about adding the extra pane of glass.

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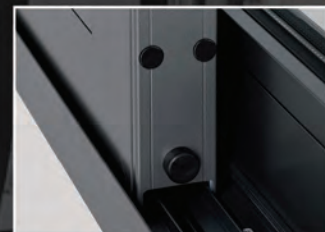
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Embodied Energy

Embodied primary energy of flat glass	2.16E+04 MJ/MT	
Middle lite thickness	6.0 mm	2.2 mm
Mass of 3rd lite per square foot of glazing	1.4 kg/ft2	0.52 kg/ft2
Embodied energy of 3rd lite per square foot of glazing	30.5 MJ/ft2	11.2 MJ/ft2

Energy Savings — Climate Zone 6

Medium office building — U lowered by 0.05 Btu/hr ft2 F, SHGC lowered by 0.03

Site energy savings	4.28 MJ/ft2/yr	
Source energy savings	14.5 MJ/ft2/yr	
Embodied energy payback period	2.1 years	0.8 years

Midrise apartment building — U lowered by 0.05 Btu/hr ft2 F, SHGC lowered by 0.03

Site energy savings	7.28 MJ/ft2/yr	
Source energy savings	11.3 MJ/ft2/yr	
Embodied energy payback period	2.7 years	1.0 years

MJ/MT = megajoule per metric ton

Assumed site-to-source conversion factor: 1.1 for gas, 3.0 for electricity

It does not include embodied energy associated with changes in the spacer edge assembly or the frame, and the specific energy savings and carbon impact for any specific building will vary based on building characteristics, location, local utility source and fuel types.

Nonetheless, the answer is clear: the embodied energy from the third lite is small compared to the energy savings, paid back quickly, and the cumulative energy savings from triple glazing in northern climates will be significant over the life of the window as well as deliver better comfort to occupants and resilience in the face of more extreme weather events. In other words, yes, the juice is worth the squeeze. ■

Tom Culp is technical code consultant for the National Glass Association and owner of Birch Point Consulting LLC.

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ON GOOD STEWARDSHIP

THE INDUSTRY CONTINUES TO PUSH FOR NEWER EFFICIENCIES WHILE GRAPPLING WITH SUPPLY CHAIN CHALLENGES. RESPONSIBLE CARE AND MANAGEMENT OF RESOURCES—IN ALL FORMS—WILL BE KEY TO SUCCESS IN 2022 **BY JOE ERB**

Resources are finite. This may sound like an obvious statement, but I think it's one that we stop and seriously consider from time to time.

As 2021 turned into 2022, this was something I found myself thinking about quite a bit, and it led me to an idea that will help guide my thinking as our industry continues to navigate a number of pressing challenges.

The idea is that of good stewardship—and how we can apply it to our daily operations as well as our larger strategic initiatives in the coming months and years. Here's how:

Efficiency and sustainability

The thermal efficiency of commercial glass and glazing has been a continuously moving target for several years now. Increasingly stringent building codes, historically adopted more aggressively by larger metropolises, have driven performance requirements higher and higher, and show no signs of slowing.

As noted, adoption throughout the U.S. has tended to vary regionally. That could change this year, thanks to the Infrastructure Investment and Jobs Act that passed Congress in late 2021. The bill includes a critical provision

providing \$225 million in grants over five years to state and local governments to adopt updated building energy codes and to train the workforce. It means we could see higher levels of adoption outside the major municipalities where we're used to seeing them. In any case, \$225 million is a significant amount of money we'll see begin to flow into the industry. Cities adopting newer codes will of course need to leverage the right technologies in new building or retrofit projects to meet the targets.

It will be incumbent upon all of us—local officials and construction professionals—to be good stewards of

those funds to maximize their impact, creating more efficient built environments. Consider that the buildings sector contributes about 30 percent of total U.S. greenhouse gas emissions. There's a significant impact we can make with strategic use of this funding for more efficient building materials.

For the commercial fenestration industry specifically, it will take the application of the right progressive technologies—including warm-edge spacer systems for large-scale commercial glass, high-performance coatings, commercial vinyl systems and more—to meet newly adopted codes reliably and cost-effectively. Warm-edge spacers, for example, can help greatly reduce the transfer of heat energy through commercial glass versus traditional metal spacers. And where applicable, vinyl windows offer outstanding thermal performance, low maintenance and a tendency to outlast the structures in which they are installed. Doing all of this in turn helps us to be better stewards of our own natural environment, an imperative for any

competitive and socially responsible company doing business today.

Raw materials and resources

Our ability to practice good stewardship extends into the manufacturing environments where high-performance fenestration products are made.

If you're reading this, you probably don't need to be reminded of the supply chain challenges our industry continues to contend with. Here, practicing good stewardship of the resources and raw materials we do have available is critical to maintaining productivity and thus, getting our products into the hands of customers.

Doing so may involve taking a close look at your plans and processes to ensure you're maximizing your materials. Implementing automated processes, which can be finely calibrated to exact specifications, can help you get the most of what's on hand while minimizing scrap. For example, manual insulating glass assembly is considerably less predictable than

comparable automated processes, especially if you have found your labor pool on the shop floor fluctuating. If a reliable IG line operator calls in sick, your production and quality rates may take a dip. Automated processes can help eliminate these potential variables.

Good stewardship of your raw materials, together with automation, can help you be sure you're using every bit of what's available to you. This is especially critical at a time when raw materials and components may be in short supply. What's more, minimizing your scrap and waste in such a way can help keep unnecessary materials out of landfills.

Good stewardship—of our resources and of our environment—is something that all fenestration professionals should be taking seriously. It's not only the right thing to do in a world where sustainability has become so important, but it can translate into a significant competitive advantage in today's marketplace. ■

Joe Erb is a commercial sales specialist with Quanex Building Products.



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AS COVID CLOUDS CHURN, MARKETS SEE MIXED OUTLOOK

BY JANICE YGLESIAS



Although the COVID pandemic storm has been described as a “blip” compared to the 2008 Great Recession, it has certainly not been trivial for those finding themselves in the eye of said “blip.” It continues to be a good news/bad news situation. In terms of good news, residential construction spending skyrocketed upward by a reported 25.3 percent during 2020, spurred by low mortgage interest rates, a low housing inventory, COVID mandates, increased remodeling due to sequestration and strong demand for bigger living spaces as stimulated by work-from-home needs.

On the bad news side of the ledger, the non-residential sector undertook

a precipitous decline during 2020, declining by a daunting 23.6 percent. While the sector appears to be bouncing back, it is difficult to know the extent to which the sector is returning to normal. A major opposing factor is the availability of materials, which is thwarting the ability of producers to meet growing demand.

“Higher materials prices and worsening skills shortages represent the primary culprits,” said Associated Builders and Contractors’ Chief Economist Anirban Basu in “Civil + Structural Engineer Media” in fall 2021. “The result is that the construction recovery is significantly slower than it would otherwise be.”

Labor scarcity

Per the Bureau of Labor Statistics through September 2021, the overall economy has 10.4 million unfilled jobs, 333,000 of which are in the construction sector (down from a 351,000 peak in April). And yet, per the U.S. Chamber of Commerce in its Third Quarter 2021 report, 55 percent of surveyed contractors report a high level of difficulty finding skilled workers. Nearly all expect the problem to stay the same or worsen into 2022. In addition, the pandemic has created absenteeism issues as well as reduced production and installation efficiency due to social distancing requirements.

Materials

A survey recently conducted by the Associated General Contractors of America determined that, as much of an uphill battle as the current labor situation is, most disruptions were found to be due to poor material availability, with 52 percent reporting shortages. The same holds true for window manufacturers, who report that, due to the global pandemic, international tariffs and competitive demand for solar panels, glass is becoming harder to find and more expensive to purchase. Some factories have had to slow or halt glass production, frustrating efforts to meet demands.

According to FGIA's most recent reporting in the September 2021 FGIA Industry Update, the forecast for non-residential window demand in 2021 saw a 4.7 percent decline, slightly down from the April forecast. The longer-term outlook for 2022 and 2023 has also weakened although still growing, with increases of 1.2 percent now forecast for 2022 and 1.6 percent for 2023. The forecast 2023 demand remains 13 percent below the 2019 peak level.

Looking ahead

FGIA's reporting expects the non-residential sector to have resumed growth at 7 percent during 2021, logging in at a total of 9.6 percent higher than the 2020 COVID lull by the end of 2022. Non-residential contract awards are forecast to have increased by 2.5 percent by the end of 2021 and continue to grow in the

following 2 years at 7.0 percent and 3.0 percent, respectively.

In general, many window manufacturers are trying to determine how much to expand capacity and hire more people to meet uncertain but potentially high demand. Complicating matters is that a commercial market resurgence usually lags, improving overall economic conditions by about 12 months. There will also be different paces of recovery across the various U.S. regions, currently led by the Midwest.

Max Perilstein, founder of Sole Source Consultants and frequent contributor to this magazine, sums it up: "Bottom line is it is still a battle out there, supply and labor rule the roost and doing everything you can to be diverse and efficient is the key." ■

Janice Yglesias is executive director of the Fenestration & Glazing Industry Alliance.



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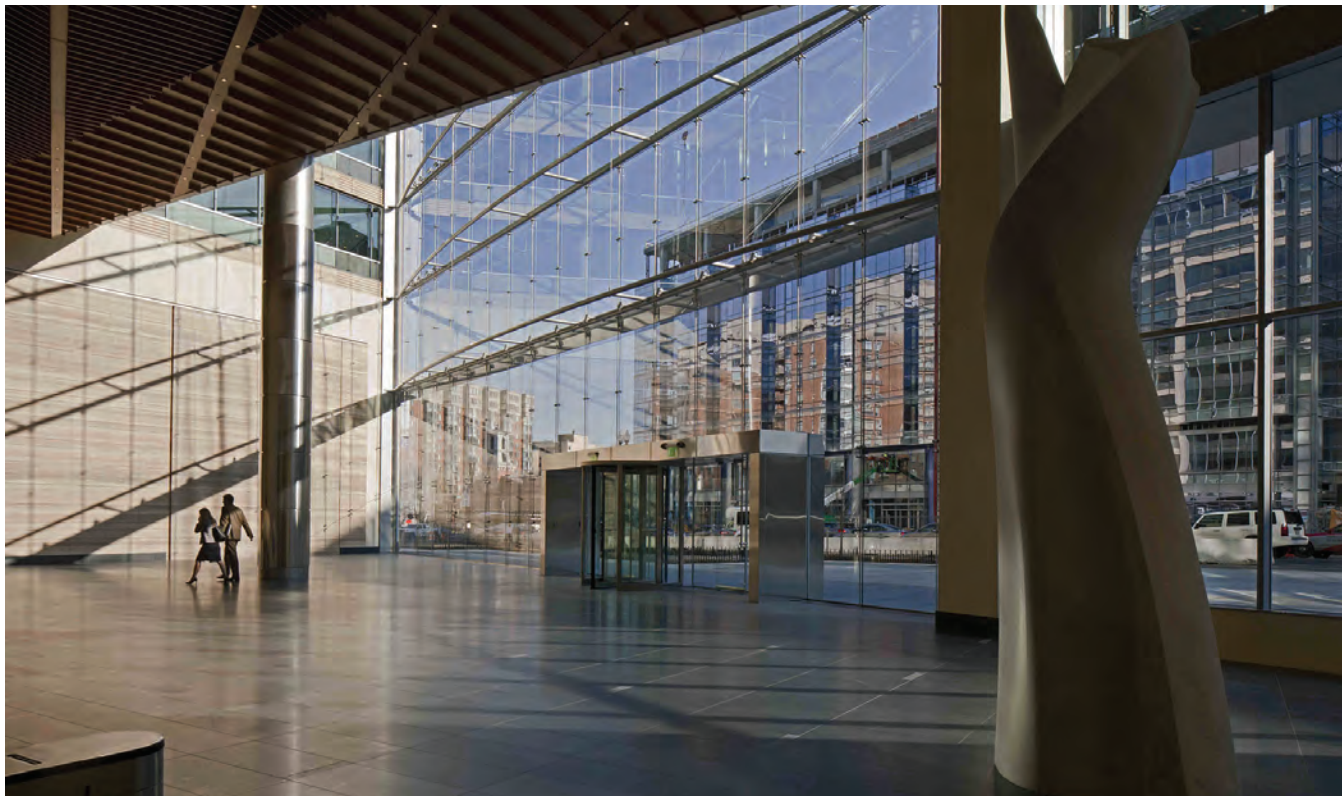
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The basics: The multimillion-dollar 601 Massachusetts Ave. development in downtown Washington, D.C., features 44,400 square meters of high-quality office space. The scheme has received Leadership in Energy and Environmental Design Gold certification, demonstrating environmental responsibility across the design, construction, operation and maintenance of the building.

The atrium: The atrium of a commercial building is one of its key selling points. It is often its first impression with prospective investors, tenants and other visitors, so it needs to impress.

It was with this in mind that developer Boston Properties and architect Duda Paine Architects specified the 10-story, almost 35-meter-tall glass façade that

fronts the atrium at the landmark 601 Massachusetts Ave. project.

The objective was to create a wall of glass that delivered maximum transparency, with minimum vertical elements, so that the whole atrium felt as much like an outdoor space as possible.

The glass and systems: The design goals were achieved using the Pilkington Planar point-supported glazing system by W&W Glass to secure panes of up to 1.5 meters by almost 3.5 meters of 12-millimeter Pilkington Optiwhite™ true low-iron glass to a series of 26-meter-wide one-piece horizontal trusses spanning the atrium.

Additional vertical support was provided by low-profile stainless steel tension rods. A total of 970 square

meters of glass was used, weighing around 29 tons.

The low-iron content of the glass means it has exceptional clarity, without the pale green tint present in standard float glass. The clean lines were further enhanced by ensuring the glass was manufactured within extremely tight tolerances in terms of roller-wave distortion—the maximum ‘peak to trough’ variation allowed was just 0.02 mm, creating an almost perfectly flat surface delivering undistorted reflections of the building’s surroundings.

The 905-series stainless steel bolts that connect the glass with the structure sit perfectly flush with the glass, maintaining the uninterrupted surface. ■



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Pictured: The factory floor of D3 Glass's facility in Ft. Myers, Florida. Bill Daubmann, president and founder, says the company faced a hiring shortage in 2021.

THE PANDEMIC, WITH SNARLS, IS GLASS BATTLE FRONTS, DAY.

LEADING FABRICATOR SALES REBOUND, BUT SUPPLY CHAIN CONDITIONS REMAIN ROCKY

Glass fabricators are staying the course, all while dealing with persistent, uncertain market conditions and production challenges.

Results from this year's Top Glass Fabricators survey reveal more clearly than ever that fabricating during the pandemic, while dealing with supply chain snarls, is fighting a battle on many fronts, every day. "From supply chain issues to maintaining a healthy company morale, we are making real-time decisions to do what is best for our people and the bottom line," says Curtis McClamrock, chief revenue officer, creative/marketing director, HMI.

Reporting companies' massive rebound in sales—63 percent reported higher sales in 2021, compared to a very small 26 percent in 2020—is heartening. But it also coincides with an industry doing more with less, possibly more so than ever before as almost all companies report dealing with shortages of people and supplies.

Another symptom of the pandemic has been industry consolidation, the most high-profile being the closing of Consolidated Glass Holdings, and the acquisition of its member companies by other fabricators and glass industry businesses. The company officially declared bankruptcy in August 2021.

Despite the upsets, some companies see reasons for optimism, at least in continued market demand. "2020 was impacted more, due to shutdowns, closures and project delays," says Adam Shearer, president, Imagic Glass. "Last year had less of these issues. We anticipate that 2022 will continue to show growth."

The Top Glass Fabricators industry ranking can be found on pages 42-44, and includes leading fabricators who supply the North American market. Market data about fabricator sales and regional growth can be found on pages 46-47. Learn about automation and capital investment trends on pages 48-49. Find information about leading fabricators' product mix and development plans on pages 50-51, and get a breakdown of major industry challenges on page 52.

THE LIST

→ The leading fabricators showcased on this list are ranked by sales category, and then alphabetically within each category. Eligible companies are those that fabricate tempered, insulating, laminated and/or decorative glass, as well as specialty glasses. Gross sales ranking

is based on companies' contributed 2021 sales information.

Some companies did not contribute sales and updated company information—in that case, information reflects data from the 2021 report.

It is only with the cooperation of the

industry that Glass Magazine can compile an accurate report. If you feel your company belongs on the list, contact Norah Dick, associate editor of Glass Magazine, at ndick@glass.org. See all Glass Magazine industry rankings at glass.org.

Glass type

T - Tempered Glass I - Insulating Glass L - Laminated Glass D - Decorative Glass J - Jumbo M - Metal

Company	Plants	Total employees	T	I	L	D	J	M	Company	Plants	Total employees	T	I	L	D	J	M
Over \$1 billion									Tvitec System Glass	7	600	•	•	•	•	•	
									tvitecglass.com								
									Cubillos del Sil, León, Spain								
Oldcastle BuildingEnvelope	84	6,500	•	•	•	•	•	•	Viracon	1	1,900	•	•	•	•	•	
obe.com									viracon.com								
Dallas									Owatonna, MN								
\$300-700 million									Vitrum Glass Group	2	500	•	•	•	•	•	
Press Glass Holding SA	14	4,900	•	•	•	•	•	•	vitrum.ca								
pressglass.com									Langley, British Columbia, Canada								
Konopiska, Poland									\$50-100 million								
Tecnoglass Inc.	6	7,500+	•	•	•	•	•	•	Aldora Glass	6	500	•	•	•	•	•	•
tecnoglass.com									aldoraglass.com								
Barranquilla, Atlántico, Colombia									Coral Springs, FL								
Trulite Glass & Aluminum Solutions	32	2,200+	•	•	•	•	•	•	Basco Shower Door	4	450	•		•	•		
trulite.com									bascoshowerdoor.com								
Peachtree City, GA									Mason, OH								
\$100-300 million									General Glass International GGI	1	250	•	•		•	•	
American Insulated Glass	7	600+	•	•	•	•	•	•	generalglass.com								
aiglass.com									Secaucus, NJ								
Atlanta									Glassfab Tempering Services	4	270	•	•	•	•	•	•
Hartung Glass Industries*	10	800+	•	•	•	•	•	•	glassfabusa.com								
hartung-glass.com									Tracy, CA								
Tukwila, WA									Glasswerks*	7	575	•	•	•	•	•	•
HMI	3	600	•		•	•			glasswerks.com								
hmiglass.com									Southgate, CA								
Louisville, KY									Grupo Tecnovidrio	5	900	•	•	•	•	•	•
Prelco Inc.	6	675	•	•	•	•			grupotecnovidrio.com								
prelco.ca									Ciudad de México								
Riviere-du-Loup, Quebec, Canada																	
Canada																	



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The List

Glass type

T - Tempered Glass I - Insulating Glass L - Laminated Glass D - Decorative Glass J - Jumbo M - Metal

Company	Plants	Total employees	T	I	L	D	J	M	Company	Plants	Total employees	T	I	L	D	J	M
Interpane interpane.com Lauenfoerde, Germany	2	600	•	•	•	•	•	•	Glenny Glass glennyglass.com Cincinnati, OH	2	107	•	•	•	•		
Tristar Glass Inc. tristarglass.com Catoosa, OK	3	220	•	•	•	•	•	•	Goldray Glass goldrayglass.com Calgary, Alberta, Canada	1	90	•		•	•		
\$30-50 million									InKan Ltd. inkan.ca Brampton, Ontario, Canada	2	60	•		•	•	•	•
Custom Glass Products customglassproductswi.com Weston, WI	3	170	•	•	•				Kensington Glass Arts kensingtonglass.com Jhamsville, MD	2	65	•		•			
Garibaldi Glass garibaldiglass.com Burnaby, British Columbia, Canada	1	245	•	•	•	•	•	•	MY Shower Door myshowerdoor.com Ft. Myers, FL	1	110	•		•		•	
Glass and Metal Craft glassandmetalcraft.com Wixom, MI	2	140	•	•	•	•	•	•	Precision Glass Bending e-bentglass.com Greenwood, AR	1	75	•	•	•	•		
Glaz-Tech Industries Inc. glaztech.com Tucson, AZ	8	275	•	•	•				Solar Seal & Solar Seal Architectural ssarch.glass Norwich, CT	2	85+	•	•	•	•	•	•
Insulite Glass Co. insuliteglass.com Olathe, KS	2	180	•	•	•	•	•	•	Southern Wholesale Glass Americus, GA	1	75		•			•	
\$10-30 million									Splendor Glass Industries splendorshowerdoor.com Holland, OH	1	86	•		•	•		
AGNORA agnora.com Collingwood, Ontario, Canada	1	76	•	•	•	•	•	•	Under \$10 million								
Consolidated Glass Corp. cgcglass.com New Castle, PA	1	65	•				•		Adriatic Glass & Mirrors Ltd. adriaticglass.com Concord, Ontario, Canada	1	50	•		•	•		
Cristacurva cristacurva.com Houston	2	350	•	•	•	•	•	•	D3 Glass d3glass.com Ft. Myers, FL	1	32	•		•		•	
Echols Glass & Mirror Inc. echolsglass.com Buford, GA	1	68	•	•			•		Dundy Glass & Mirror Corp. dundyglass.com Springfield Gardens, NY	2	25	•	•	•		•	
FGD Glass Solutions fgdglass.com Suwanee, GA	1	40			•	•	•		Imagic Glass Inc. imagicglass.com Toronto	1	25+	•		•	•	•	•
Flat Glass Distributors flatglassdistributors.com Jacksonville, FL	1	75	•	•			•		Over the Mountain Glass otmglass.com Birmingham, AL	2	50	•	•			•	
Glas-Pro Glas-Pro.com Santa Fe Springs, California	1	100	•	•	•	•	•	•	Tempco Glass tempcoglass.com Flushing, NY	1	60	•	•			•	

THINK BIG THINK GLASSWERKS™



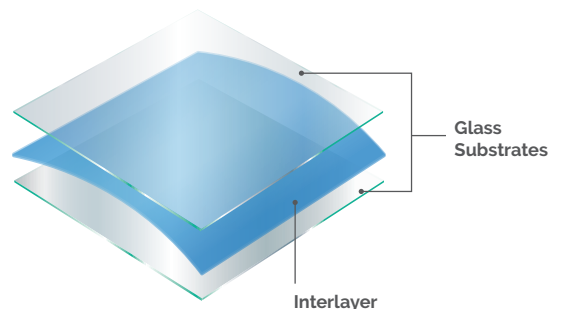
Glasswerks Laminated Glass

Glasswerks laminated glass is available in a wide variety of configurations for diverse glazing applications. Glasswerks laminated products encompass a vast spectrum of performance and design options. Combinations of glass substrates, interlayers, screen prints, low-e coatings, curved glass all provide extensive design options to meet specified performance levels required for today's glazing environment.

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- Jumbo Laminated Glass
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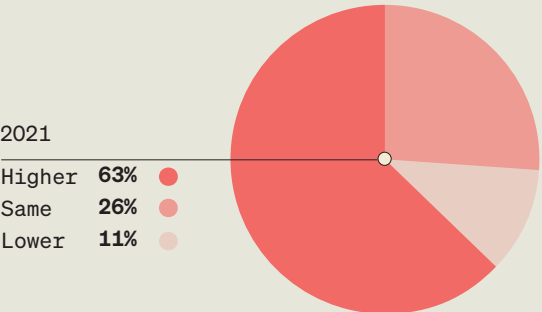
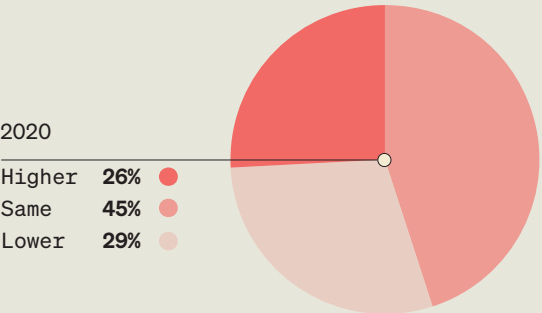
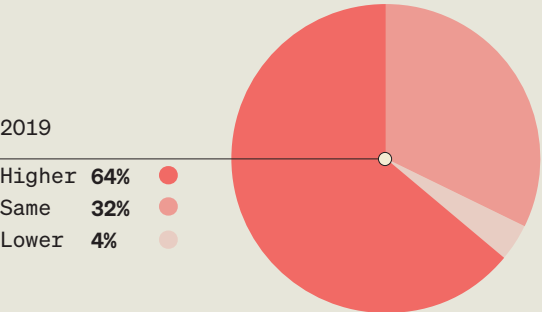


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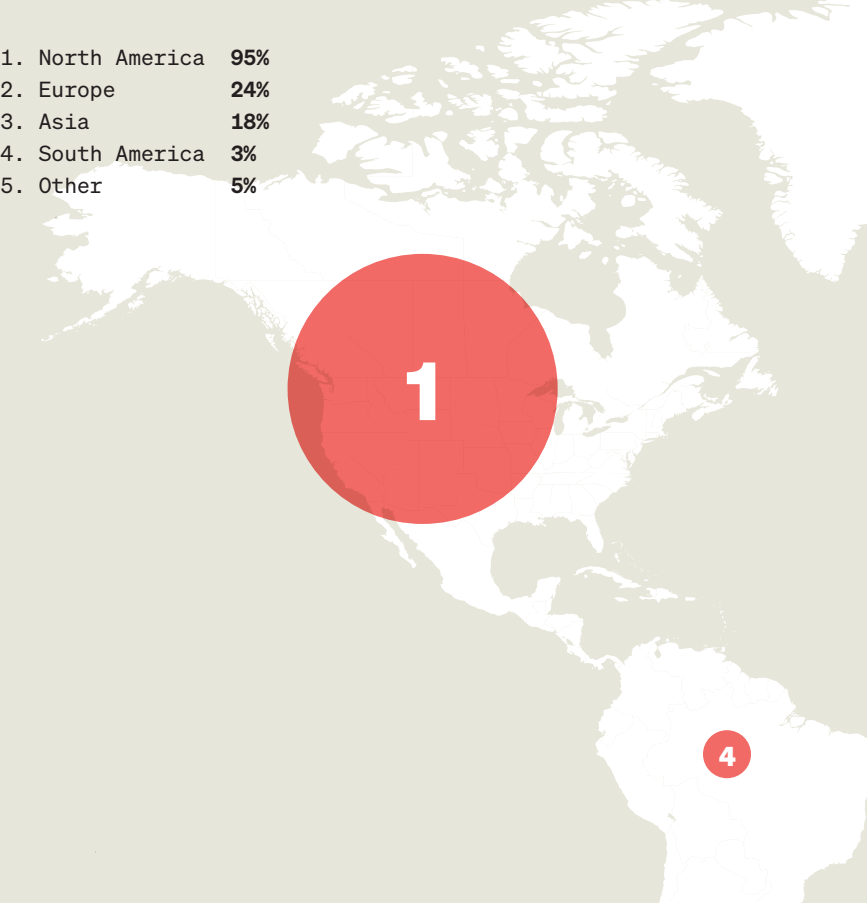
REBOUNDDING SALES

How did sales levels compare to the previous year?

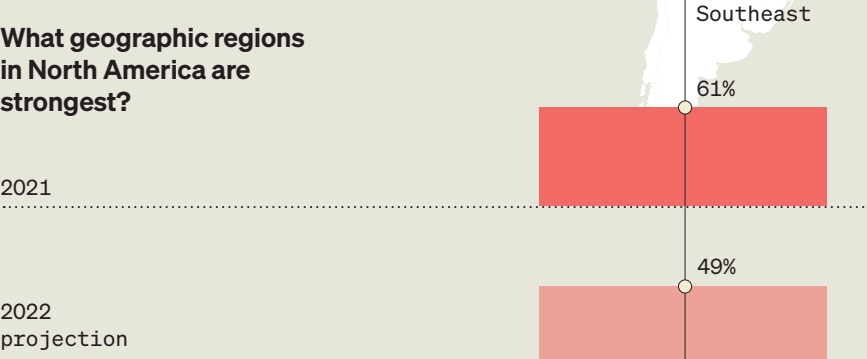


Where did you purchase raw glass from in 2021?

- 1. North America 95%
- 2. Europe 24%
- 3. Asia 18%
- 4. South America 3%
- 5. Other 5%



What geographic regions in North America are strongest?

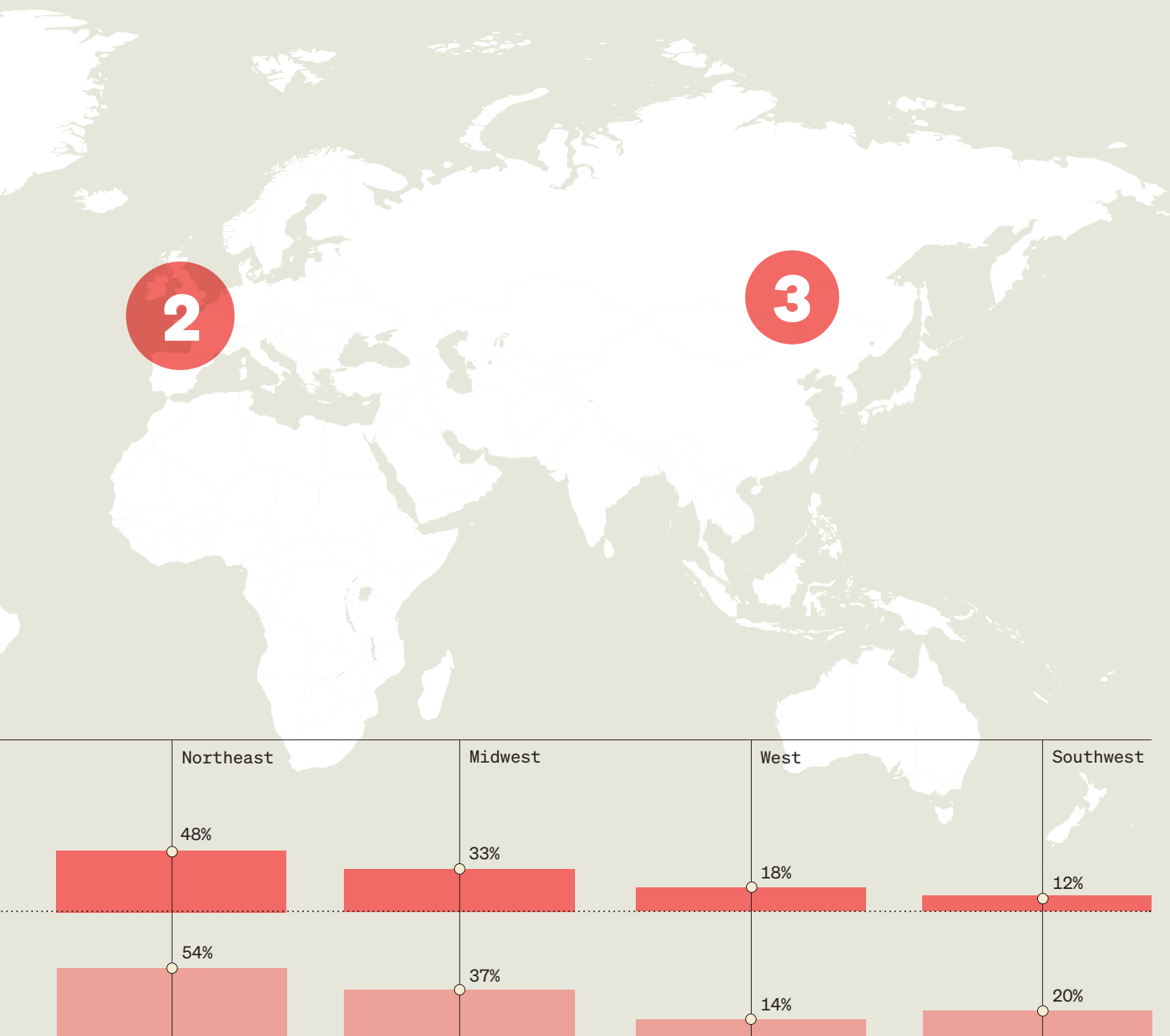


→ Gross sales data for 2021, supplied by reporting Top Glass Fabricators, reflect patterns more similar to 2019's posting. This is unsurprising, given that 2020 required many companies to fully shut down, at least for a period. Sixty-three percent of companies reported higher sales in 2021, compared to 26 percent in 2020. Perhaps more importantly, only 11 percent of companies reported lower sales this

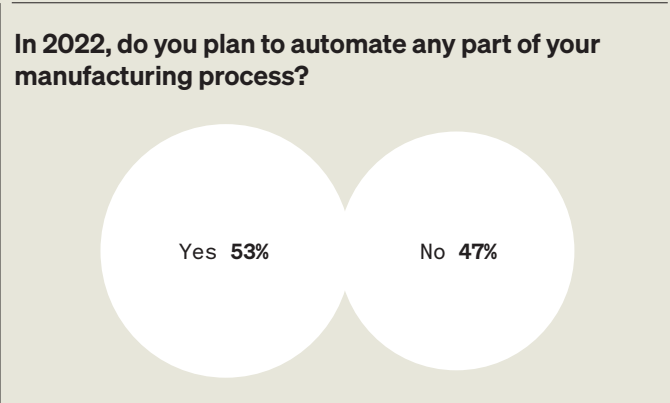
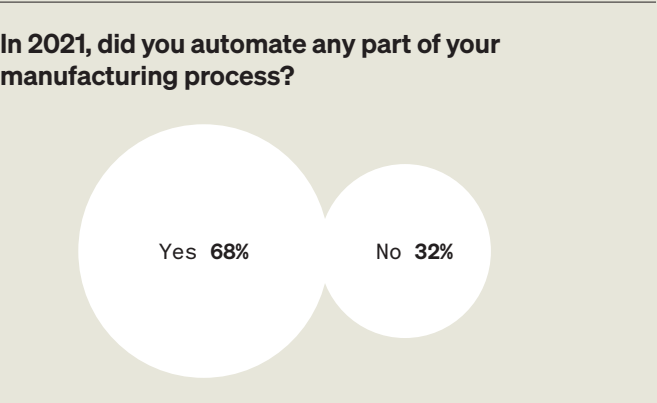
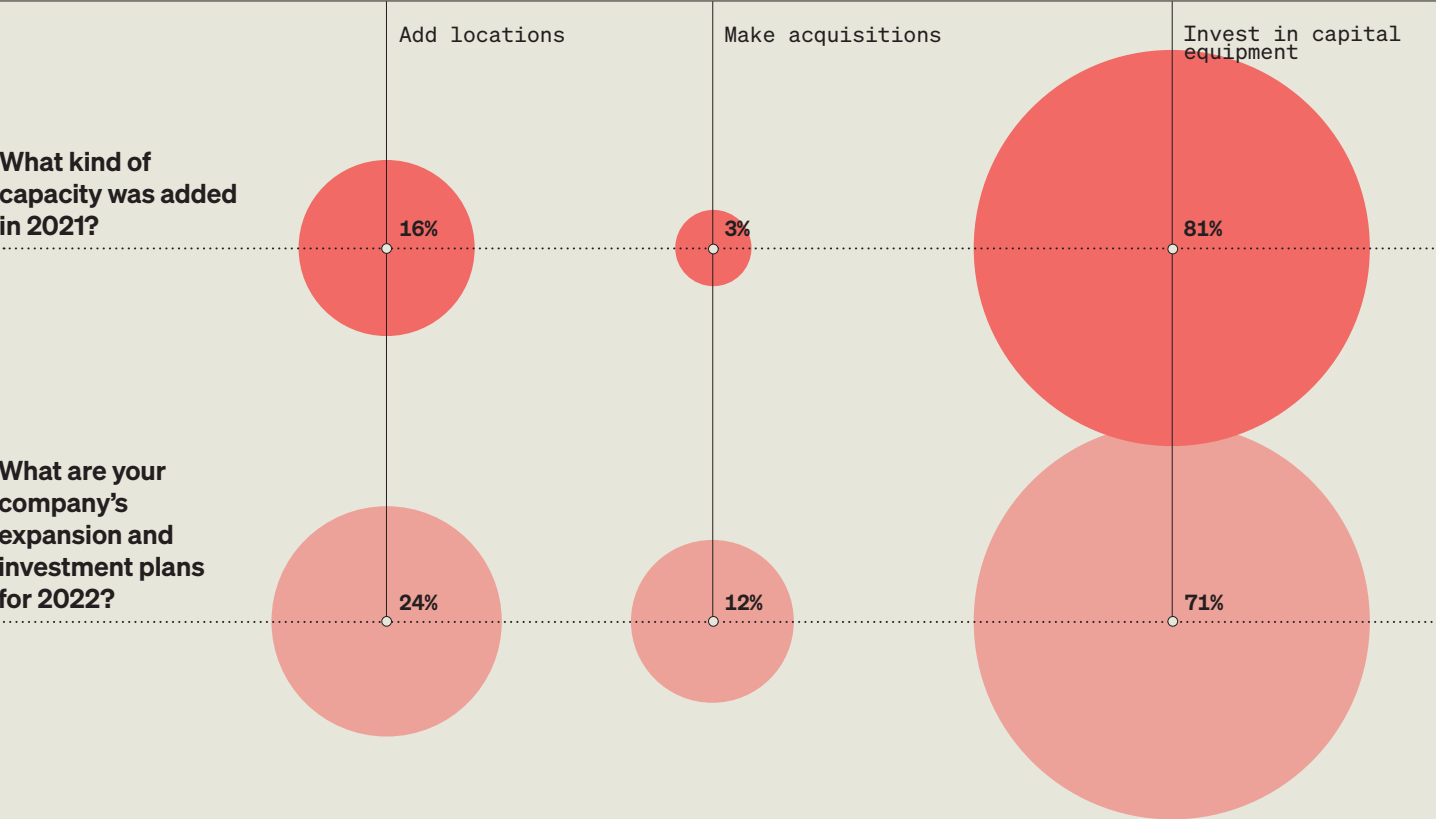
year, compared to 29 percent last year.

Getting glass remains a challenge for many fabricators. Based on reporting, fabricators are buying glass from roughly the same places as last year, with 95 percent getting raw glass from North America. Compared to last year's results, fabricators appear to be sourcing glass less from abroad, most likely due to supply chain and logistics issues.

Looking at regional markets, last year's prediction that the Southeast would see the most growth came true, according to survey respondents, as 61 percent said the region had been the strongest in 2021. Looking forward, fabricators identified building growth shifting back to the Northeast, though the Southeast looks to remain strong, according to fabricator predictions.



CREATING CAPACITY



→ A majority, 68 percent, of responding fabricators said they automated some part of their manufacturing in 2021. A majority also say they will automate processes in 2022, and a significant majority, 79 percent, say that they are using more software for plant optimization.

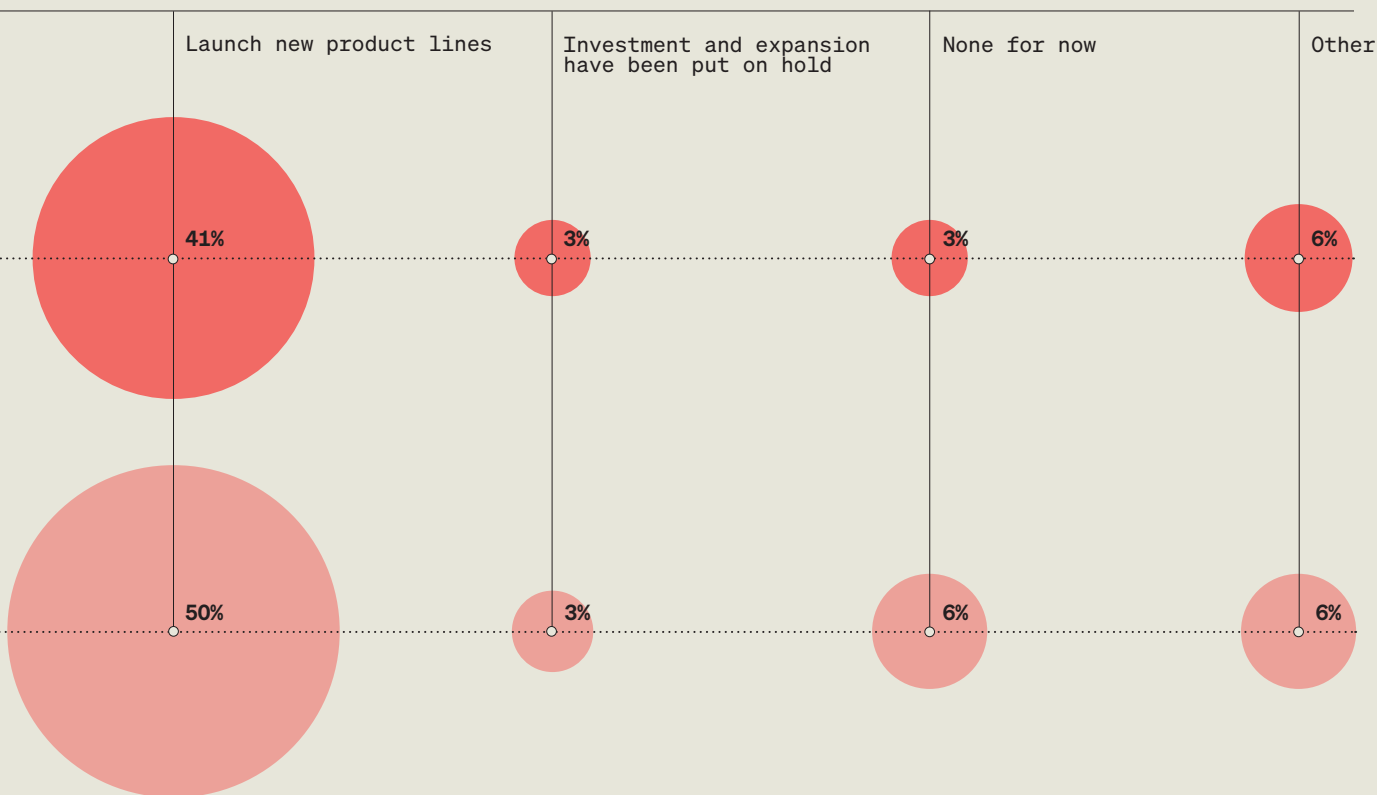
Fabricator testimonials suggest that the main driver for automation is the sustained labor shortage, combined with a return to more normal production volumes. “Given the anticipation of future staffing shortages we will continue

to look to automation to assist with keeping up with demand,” says Doug Betti, director of operations, Viracon.

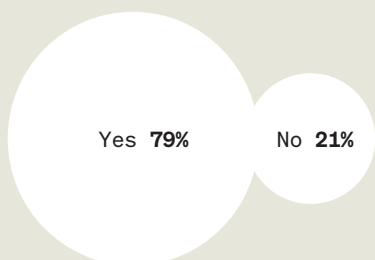
Leading fabricators seem to have used this year to invest in their business, as 89 percent report adding production capacity in 2021, compared to 68 percent the previous year. In terms of what they added, fabricators did what they said they would in last year’s report, and invested in capital equipment. Investing in equipment remains the top priority again for 2022.

Glenny Glass is one example of

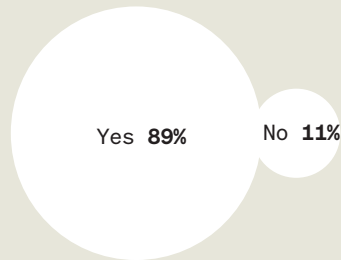
a company that added a range of equipment to their floor. “Glenny is automating any manufacturing process possible,” says Braxton Smith, president. “We recently added auto logo-ing, auto seaming at the furnace infeeds, installed a vertical CNC milling, drilling and profile edging machine. We are looking at in-line QC inspection scanners to detect quality defects early in the fabrication process, which will reduce internal rejects.”



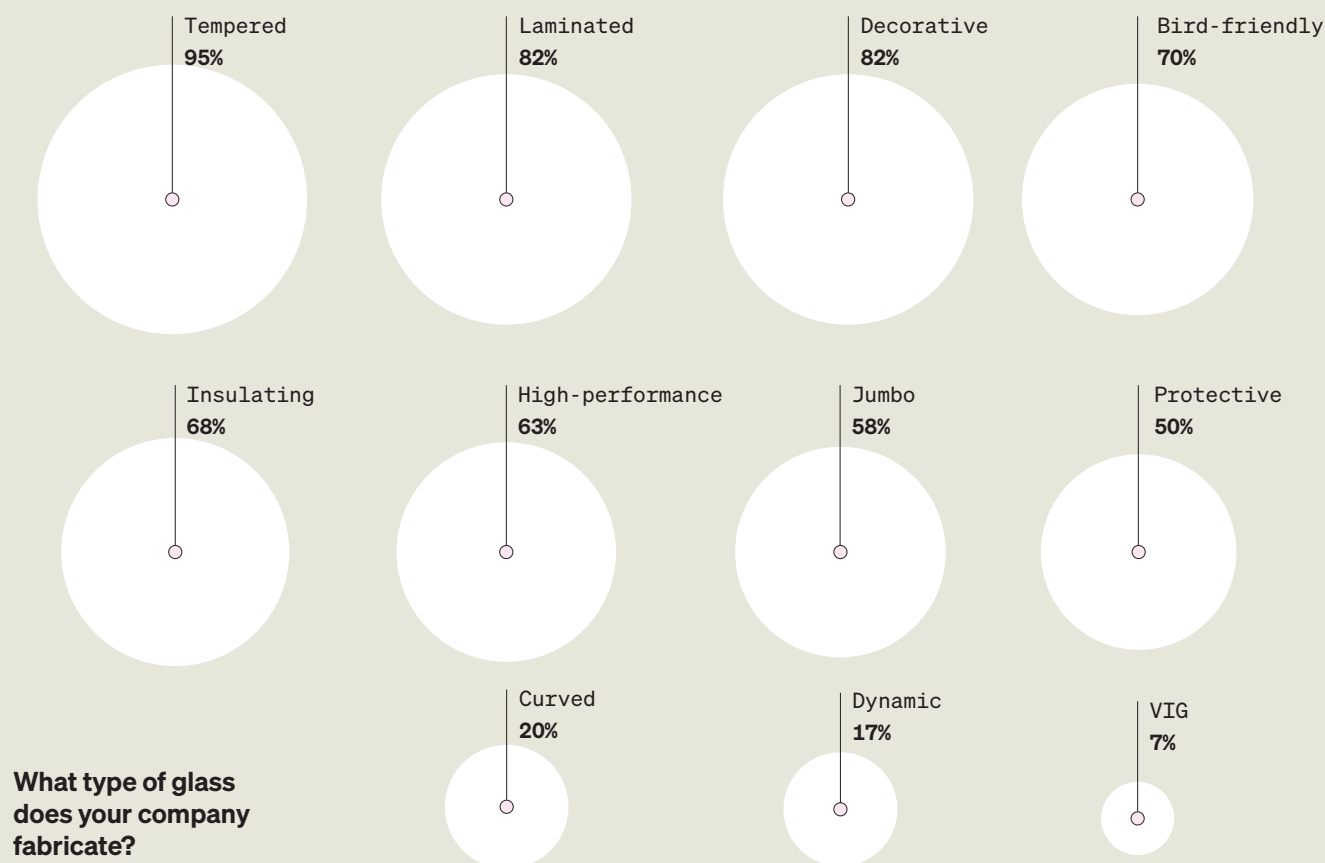
Are you using more software for plant optimization?



Did your company add production capacity in 2021?



EXPANDING GLASS



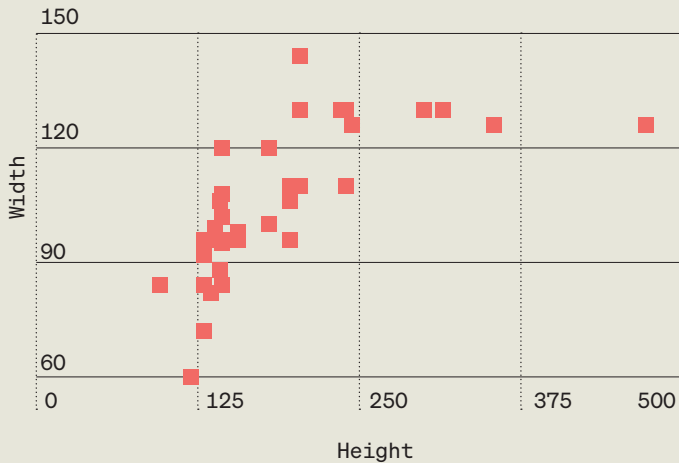
→ Companies continue to innovate products; about 41 percent said they launched new lines in 2021, practically the same number as in 2020.

Jumbo will continue to lead the way in terms of specialty glass, as 71 percent of fabricators noted it as a strong trend in 2021, up from only 45 percent in 2020.

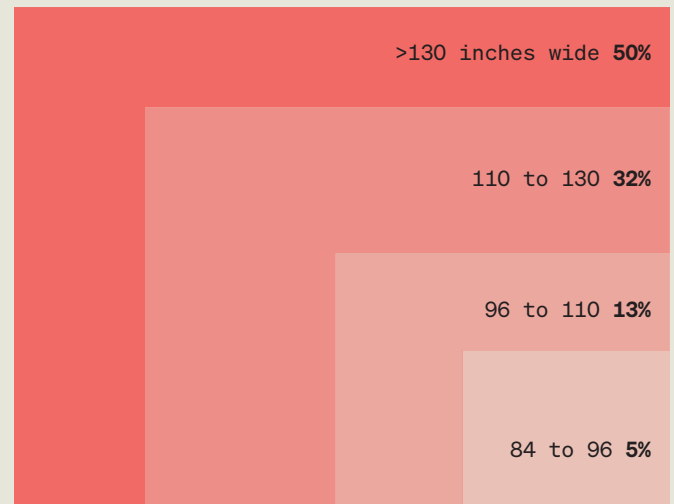
Fifty-eight percent of companies say they fabricate jumbo glass, compared to 64 percent last year. The discrepancy may be due to the fact that jumbo does not yet have a standard size. When asked to choose a size range they thought to be “jumbo,” half of respondents said glass that is more than 130 inches wide.

The bird-friendly glass market also continues to expand. Seventy percent of fabricators say they made this specialty glass in 2021, compared to only 42 percent last year, and 59 percent noted it as a major design trend for 2021. Moreover, more fabricators report fabricating bird-friendly glass than even insulating glass.

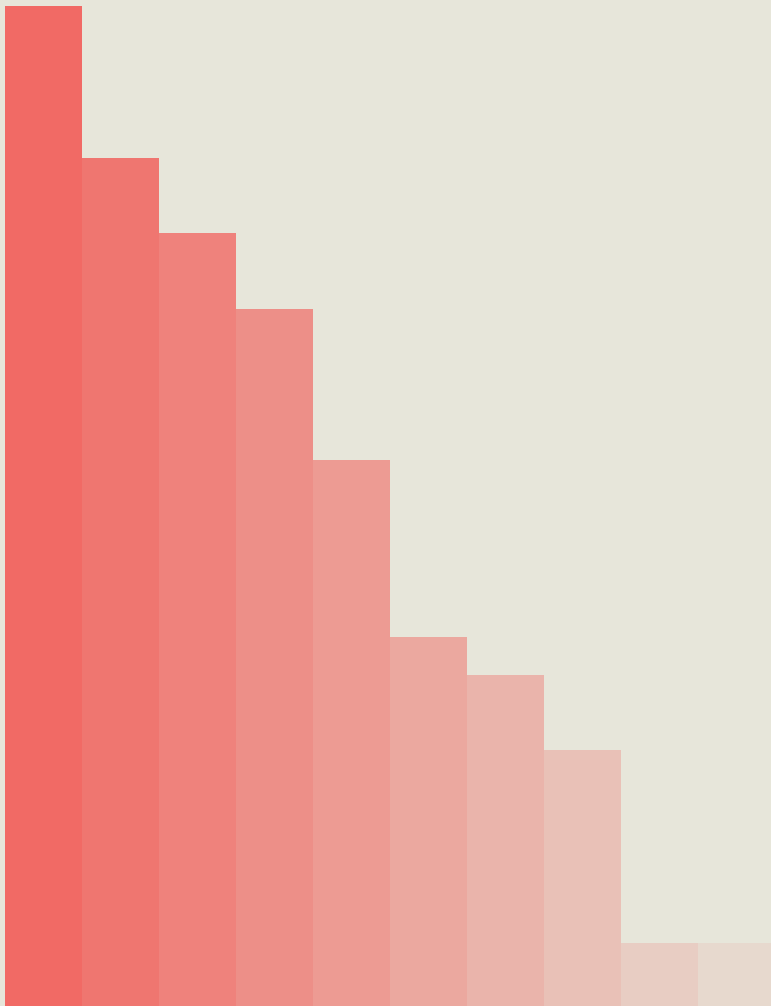
What is the maximum size glass you are able to fabricate? (in inches)



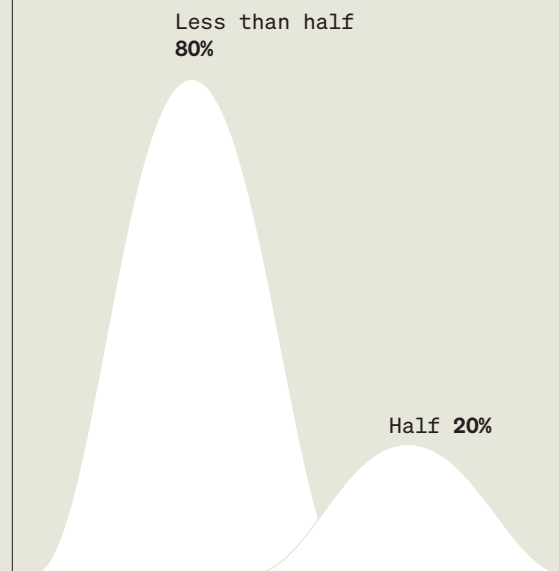
What size range do you consider to be jumbo glass? (width in inches)



What design trends have you noticed in the last year?



What percentage of your business is retrofit?



- 71% More jumbo glass
- 59% Bird-friendly
- 53% Energy-efficient glass
- 47% Security glass/impact systems
- 35% Decorative glass
- 21% Division 10 interiors
- 18% Dynamic glass (switchable)
- 12% Anti-viral/anti-bacterial coatings
- 3% Transparent PV
- 3% Laminated glass

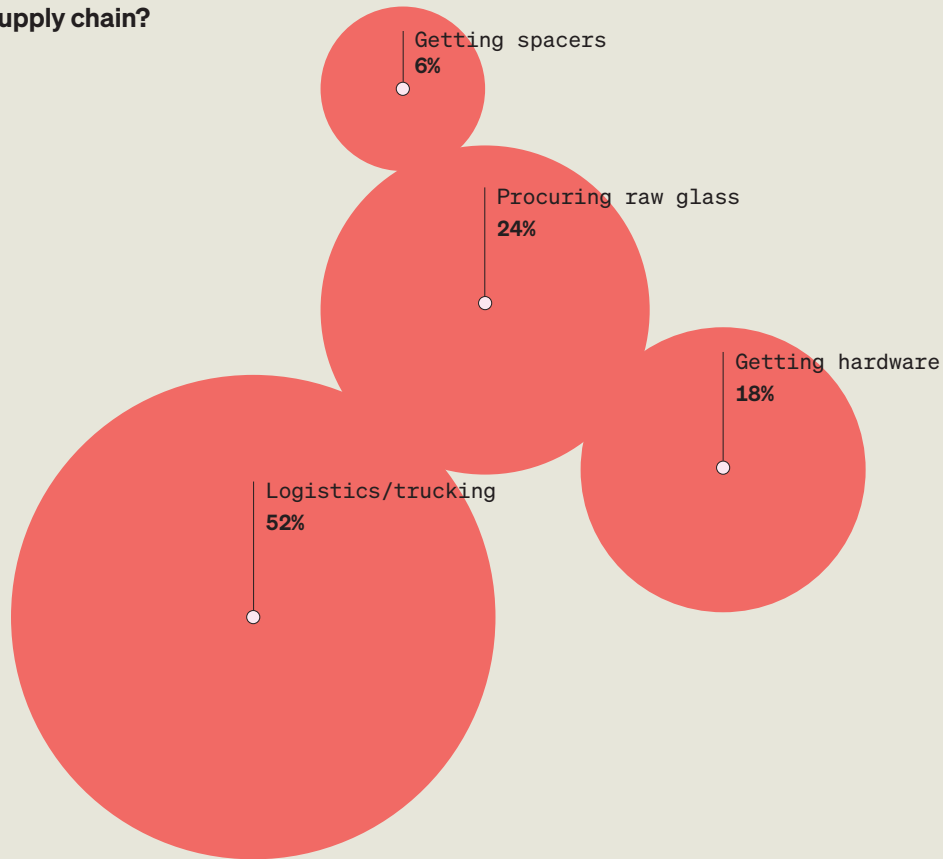
FINDING TRANSPORTATION

→ Regrettably, fabricators continue to face an array of challenges, especially as supply chain issues become increasingly complex. Respondents identified logistics and transportation as the biggest hurdle in 2021, forcing fabricators to improvise. “In-bound trucking has been limited causing [Glaz-Tech Industries] to invest in OTR freight hauling trucks and trailers to bring in glass from manufacturers,” says Alex Miramontez, vice president and chief financial officer for Glaz-Tech.

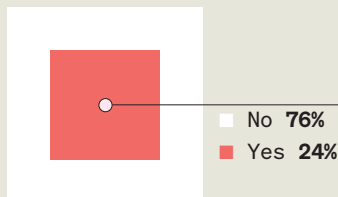
While getting raw glass remains a challenge, as Ryan Walker, branch manager for Southern Wholesale Glass, points out, delays on any component involved in production all disrupt processes and lead times. “All areas of the supply chain are equally impactful,” he says. “It doesn’t matter if we can get glass, but not spacers and vice versa. Things that people don’t consider have been difficult to get, but they are necessary for the process—cork or synthetic tabs, or the labels that we put on our glass, for example.”

Companies continue to struggle to find labor, based on respondents’ testimonials. Some fabricators report raising wages, or paying overtime, to keep up with demand with a still-small labor pool. “We’ve had to increase pay to keep pace with the local fast food and big box stores on even basic labor, as well as the government incentives that are being paid out,” says Andrew Russo, vice president sales and engineering services, Glass and Metal Craft.

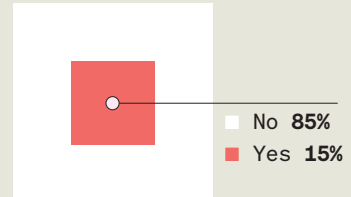
What is your biggest pain point in terms of supply chain?



Did you add shifts during 2021?



Did you reduce shifts during 2021?





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STANDOUT PROJECTS

Top: 81 Bay St, CIBC Square, Toronto, Canada. This was a public art project, fabricated by Imagic Glass, for the building's lobby and podium. Steve Driscoll was the artist.

Left: Shower enclosure, part of a lake house renovation for Lisa Sherry, interior designer. HMI partnered with her to produce several digitally printed pieces.

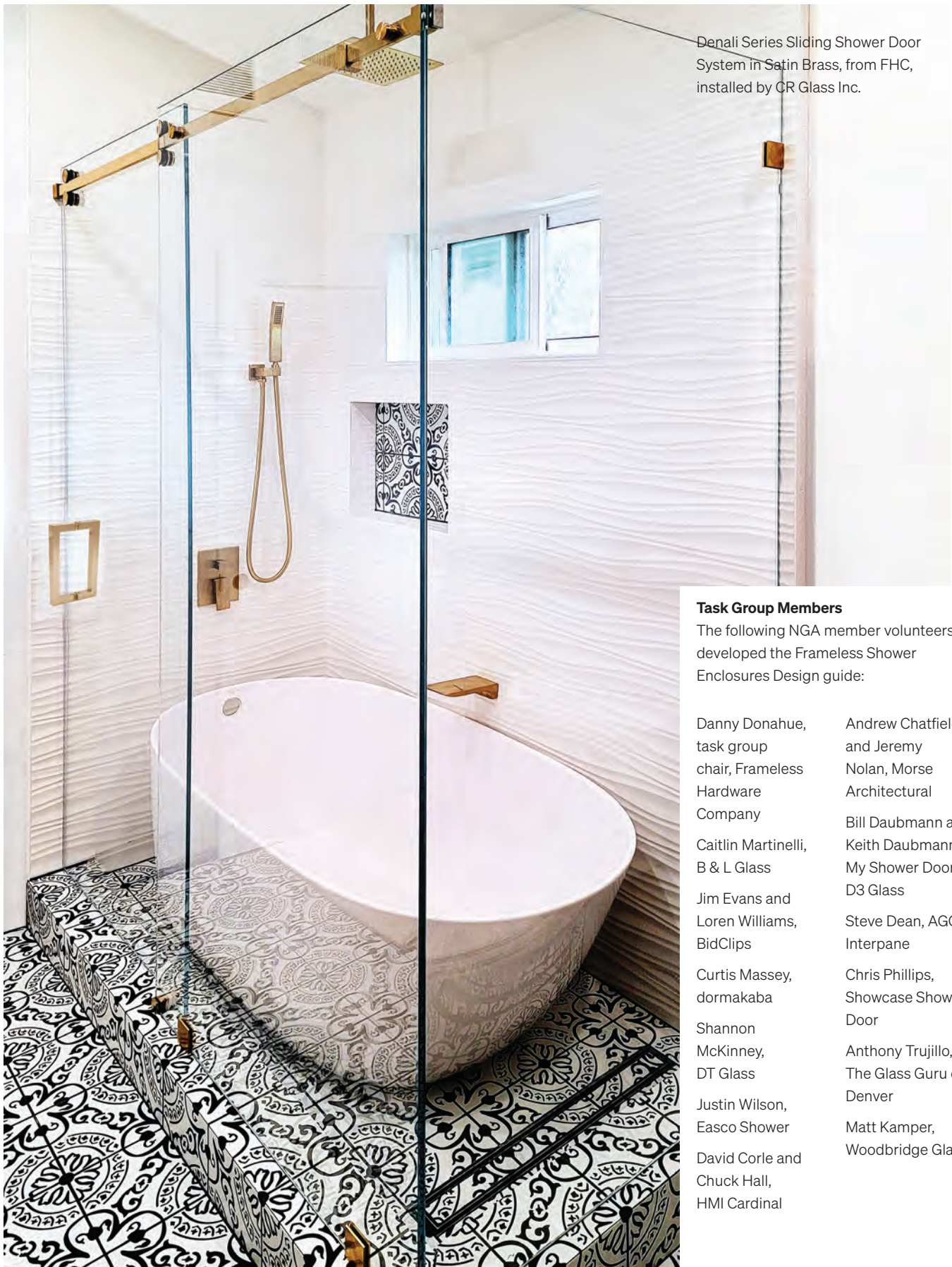


Left: Windward Light, a public art installation located in Township Community, Calgary, Alberta, Canada. Goldray Glass supplied its decorative, dichroic glass to the project. Photo by Ron Eliovitz.

Bottom Left: An Englington Crosstown LRT station, in Toronto. Prelco used silkscreening and digital printing to create the bird-friendly patterns of the fabricated glass, part of the facade of 14 of the city's Metrolink stations.

Below: Observation Deck, interior, of One Vanderbilt in New York City. Cristacurva supplied fabricated glass to the new skyscraper.





Denali Series Sliding Shower Door System in Satin Brass, from FHC, installed by CR Glass Inc.

Task Group Members

The following NGA member volunteers developed the Frameless Shower Enclosures Design guide:

Danny Donahue, task group chair, Frameless Hardware Company	Andrew Chatfield and Jeremy Nolan, Morse Architectural
Caitlin Martinelli, B & L Glass	Bill Daubmann and Keith Daubmann, My Shower Door/ D3 Glass
Jim Evans and Loren Williams, BidClips	Steve Dean, AGC Interpane
Curtis Massey, dormakaba	Chris Phillips, Showcase Shower Door
Shannon McKinney, DT Glass	Anthony Trujillo, The Glass Guru of Denver
Justin Wilson, Easco Shower	Matt Kamper, Woodbridge Glass
David Corle and Chuck Hall, HMI Cardinal	

TOP GUIDELINES AND CONSIDERATIONS FOR FRAMELESS SHOWER ENCLOSURES

Safe + Beautiful + Frameless



↑
SCAN
THE
CODE TO
ACCESS
THE
FULL
GUIDE.

Editor's note: This article is excerpted and adapted from the National Glass Association's Frameless Shower Enclosures Design guide. Download the full guide in the NGA Store using the code at left.

Frameless glass shower enclosures can add a contemporary aesthetic to residential and commercial bathroom designs. Frameless shower enclosures are constructed of clear, translucent or opaque tempered glass, with optional colors, tints and textures. According to the International Building Code, shower enclosure glass must be safety glazing meeting the impact requirement of the federal standard, Cat II of CPSC 16 CFR 1201.

This article will discuss design considerations for frameless shower enclosures including doors and fixed panels, dimensional tolerances and limitations, hardware and structural support, visual quality expectations, and cleaning and maintenance guidelines.

What glass should be used in frameless shower enclosures?

This category of shower enclosure typically uses monolithic tempered glass a minimum of $\frac{3}{8}$ -inch or thicker. Laminated glass may be used when glass retention after breakage is desirable. Consult the interlayer manufacturer for structural properties and durability in wet and humid environmental conditions.

What does “frameless” mean when it comes to shower enclosures?

In operating panels, “frameless” refers to the swinging, sliding, or moving panel(s) of the enclosure with no full-length metal attachments on the top, sides or bottom.

For stationary or sidelite panels, the “frameless” definition may or may not apply.

The use of framing to support a stationary panel depends on the intended function of the stationary panel, including water management and structural support.

For water management, a short, narrow stationary panel that is primarily intended to stop water from escaping the enclosure, for example, can be secured with a few clips, channels on the bottom and one vertical edge or even a vertical silicone butt joint to another piece of glass.

Some sidelites are also intended to provide structural integrity to the unit in terms of:

- Carrying the load of sliding or hinged doors where the sidelite may only have one exposed frameless edge because a header must be used for safety and functionality.
- Supporting the size and weight of the sidelite panel itself; the taller and wider a panel, the more bracing or anchoring



HMI Cardinal's shower enclosure for interior designer and influencer Lisa Sherry. The glass is HMI's printed privacy screen Priva-Tech in Linen.

would be required.

- Withstanding loads related to people leaning or falling into the panel. This may be necessary when a panel is installed in a high-contact or high-traffic area of an enclosure.

Will a frameless shower leak?

A frameless shower enclosure is not the same as its framed or semi-frameless counterpart. There is minimal use of hardware, leaving an all-glass look. This all-glass look does not allow for a kit that is assembled and has aluminum extrusions that interlock into one another, preventing water from leaking. An end user should be prepared for these differences and have expectations that align with this knowledge. A frameless shower is not an aquarium, meaning it will not hold water without any leakage.

The amount a frameless shower will leak is dependent on various factors. The primary factors are the configuration of the shower itself and the type of enclosure being installed. There are some showers

that, by virtue of their design, will not have water escape. For example, a very large shower with the door far away from the water source will be unlikely to leak water outside of the enclosure.

A shower type on the other side of this spectrum may be, for example, a corner-installed enclosure of small proportions, which would be almost guaranteed to leak. Most showers fit somewhere between these two extreme examples.

Clear plastic seals do assist in minimizing water escape. However, they do not ensure a leak-proof shower.

What are the width and weight limits on operable doors?

The width and weight limitations for operable doors—sliding and swinging—are determined by the manufacturer of the selected hardware. Hardware manufacturer width and weight limitations should be followed and maintained. No implied performance should be assumed based on any similarities in hardware from different manufacturers. Strict adherence

to the manufacturer's specifications is required. Structural wall construction is normally required to support the weight of a side-mounted hinged door.

(See the design guide for recommendations and details for single doors with three-wall mounting hinges.)

What are the size limits for fixed panels?

The vast majority of frameless shower enclosures are assembled using $\frac{3}{8}$ -inch and $\frac{1}{2}$ -inch-thick glass. Glass thickness is typically determined based on three factors: total height, total width and total square area. (See the complete design guide for industry-standard panel size and thickness limitations based on the panel support configuration.)

Generally, the maximum height for $\frac{3}{8}$ -inch glass is 84 inches, regardless of the width, when supported on two vertical edges and the base, or on two horizontal edges. The maximum height for $\frac{1}{2}$ -inch glass is 120 inches, regardless of the width, when supported on

PROFESSIONAL GRADE

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FHC has everything you need to design and install elegant, Frameless Shower Enclosures. We carry a comprehensive stock selection of the most popular styles and finishes, including: hinges, clamps, handles/pulls, towel bars, seals/wipes, headers, extrusions and sliding systems.

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Left: Headerless neo-angle frameless enclosure from Showcase Shower Door Company. **Right:** Morse Architectural's Tranquility Gliding System. Courtesy of GDK Builder Services.

two vertical edges and the base, or on two horizontal edges.

The maximum width for $\frac{3}{8}$ -inch-thick glass with an unsupported corner is 30 inches, if full height and/or adjacent to a door. The maximum width for $\frac{1}{2}$ -inch-thick glass with an unsupported corner is 36 inches, if full height and/or adjacent to a door.

What are the weight limitations for fixed panels?

Maximum panel weight considerations vary significantly depending upon whether the fixed panels are floor supported or suspended.

For the case of fixed panels that are floor supported, when the panel is installed plumb, there is no real weight for the clamps to support. A plumb fixed panel, conceptually, has no reason to "fall" one way or another. If the glass is reliably resting on setting blocks at the bottom, and is installed plumb,

there would not normally be a need to put weight limitations on a fixed panel, assuming the substrate upon which the panel is resting is sufficient to support the weight.

Suspended panels are not recommended in a frameless shower enclosure.

What are the glass fabrication tolerances that should be followed?

ASTM C1048 Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass provides fabrication guidelines for tempered glass including, but not limited to, holes, notches, cutouts, minimum dimensions and tolerances. Some hardware may require fabrication to more stringent tolerances than ASTM C1048 guidelines. In those instances, the purchaser should consult with the glass fabricator.

When should a design professional be consulted?

Contact a design professional for designs that feature $\frac{3}{8}$ -inch-thick glass over 84 inches, and $\frac{1}{2}$ -inch-thick glass over 120 inches in height. Additionally, consult a professional regarding hardware weight limitations based on substrate material or

support capability. Examples of substrates requiring further considerations include walls with the tile applied directly on drywall without stud framing behind the fastening location, or installation directly on drywall with no cladding or cover material.

What else is in the design guide?

The complete 15-page design guide offers additional guidance and detail on the topics addressed in this article, in addition to design recommendations and details for single doors with three-wall mounting hinges, maintenance and cleaning tips, guidelines for retrofit installations, and more.

The guide provides numerous reference tables for: fixed panel height limitations for frameless glass panels; fixed panel size limitations for frameless glass panels with an unsupported top corner; glass fabrication requirements for frameless shower enclosures; allowable point blemish size and distribution for cut size quality; and allowable shell chip size and distribution for cut size and stock sheet qualities. The guide also includes figures demonstrating the concepts and guidelines addressed in the guide. ■

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PRODUCTS

01



02

01. Decorative glass

Privacy Glass Solutions launched its new Deco Glass offering. The enhanced collections streamline the supply chain for customers seeking various styles of privacy glass for a single project, say officials. The new Deco Glass product line features two main collections: DecoPrint and DecoColor. These collections are completely customizable and offer customers the ability to adjust patterns, colors, gradients and opacities to achieve a design vision.

866/466-9525 | PRIVACYGLASSSOLUTIONS.COM

02. Glass railing

The Trex Signature railing collection combines versatile styling and easy installation with the strength and sustainability of aluminum. Suitable for both interior and exterior applications, the design is engineered to optimize sightlines, making it ideal for staircases, balconies, patios, decks and public walkways. One-piece rail sections are designed to accommodate a range of infill options, including tempered glass panes. Additionally, sections can be installed with continuously graspable rail options for added safety, comfort and functionality.

877/215-7245 | TREXCOMMERCIAL.COM

Glass systems *(not pictured)*

As Pilkington Architectural halts production of the Pilkington Planar system in St. Helens, U.K., as of Dec. 31, 2021, W&W Glass announced it will offer its own glass engineered solutions. They include everything from unitized curtain wall to custom storefronts, skylights and more. Company officials also say that all warranties on existing manufactured projects will be honored based on the terms of Pilkington's warranty.

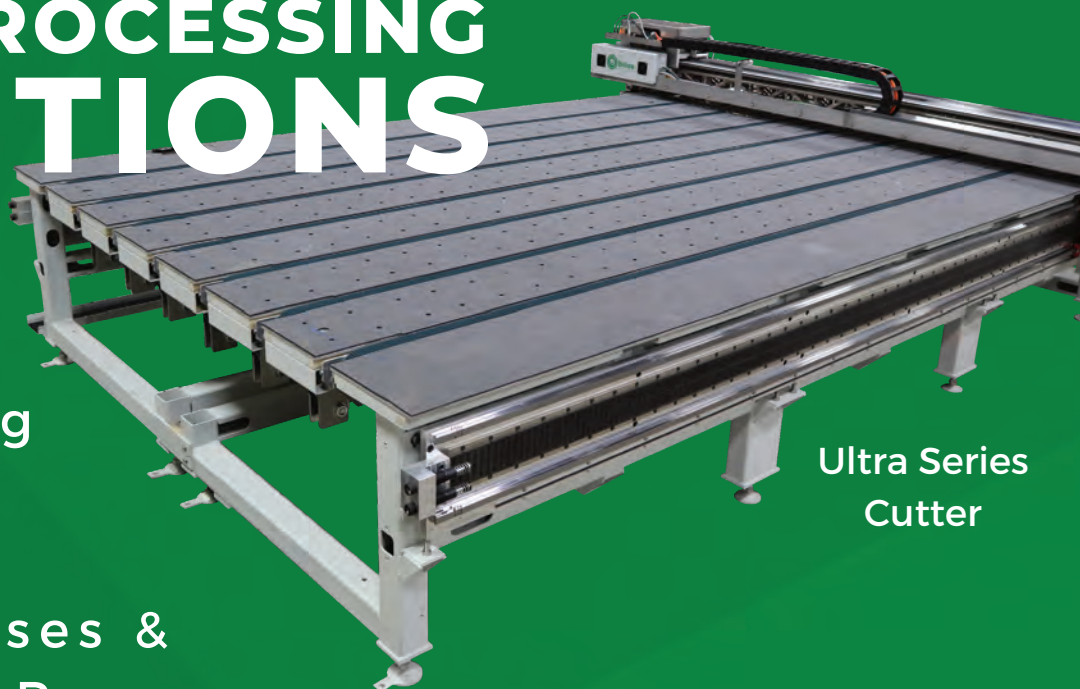
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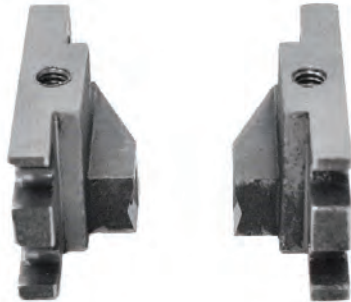
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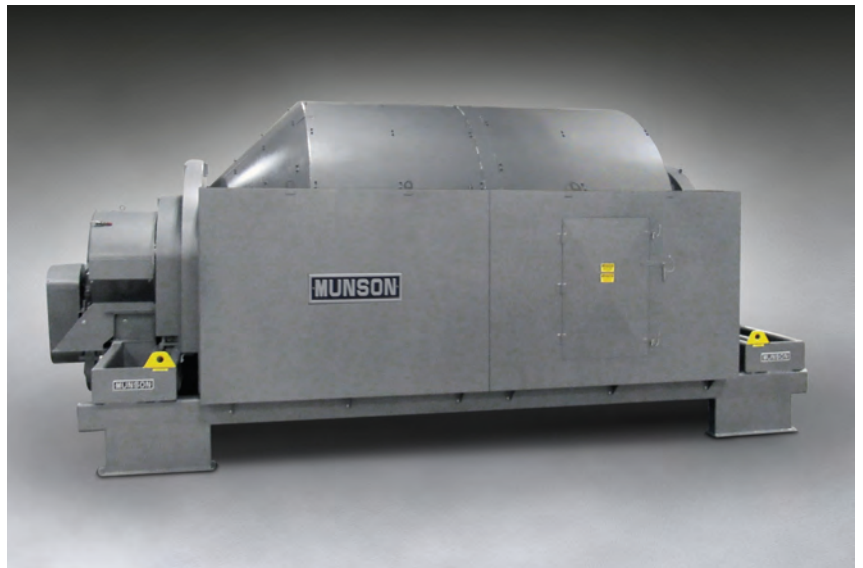
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03

01



02



01. IG technology

Vitro Architectural Glass and GED Integrated Solutions launched Intercept LiteLock, a new extruder tip and sealant bead application system that provides licensees of Intercept insulating glass technology with quality improvements. The product facilitates 30 to 50 percent faster processing speeds on GED's Intercept oven and roll press, while creating a wider manufacturing process window. This results in a more consistent, uniform and secure seal between the Intercept spacer and the glass lite.

855/887-6457 | VITROGLAZINGS.COM

02. Mixer

A new Munson Rotary Batch Mixer model 700-THCX-600-MSL blends abrasive materials in six to eight minutes with total uniformity and little to no shear, degradation or heat. Constructed of carbon steel, the mixer is intended for demanding applications including ceramics and powdered metals, as well as glass and fiberglass. It has a useable batch capacity of 600 cubic feet and achieves uniformity with equal efficiency from 100 percent to 15 percent of rated capacity.

315/797-0090 | MUNSONMACHINERY.COM

03. Locks

Roto North America introduced its multi-point lock and new adjustable strikers for a 4-point locking system. This new product offers robust hook-style locking points with two opposing primary hooks and an additional outward-facing hook 28 inches from each side of the center line. Manufactured at Roto Fasco Canada, the locks are produced with an anodized aluminum faceplate and 300 series stainless steel drive rail, which provides corrosion resistance.

800/243-0893 | ROTONORTHAMERICA.COM



04

05



04. Delivery

St. Cloud Window Inc., a manufacturer of high-performance commercial aluminum fenestration products, is offering a quick ship program for its SCW3000 Series projecting and fixed window products. These products are ideal for historic applications and an option for contemporary, luxury and mountain architecture. Fastest delivery is available for products with a black Kynar painted finish. The SCW3000 Series windows have a narrow sightline to replicate steel, and a thermally-broken frame depth of three inches.

800/383-9311 | STCLOUDWINDOW.COM

05. Safety gloves

Magid introduced its new coreless T-rex TRDXG49 gloves that provide industry-leading protection while keeping the wearer cool and comfortable. The TRDXG49 is the first impact-resistant glove to incorporate Magid's TriTek Palm coating on a DX Technology coreless shell. TriTek provides more than twice the abrasion resistance of other coatings, say officials, in its unique, multi-layered construction, with an outer layer that absorbs oil for a rock-solid grip and an inner layer that deflects oil to keep hands dry.

800/867-1083 | MAGIDGLOVE.COM

Design program *(not pictured)*

Frameless Hardware Co. updated its shower design program to include its line of sliding shower door systems. Customers can now select from Denali, Clearwater, Pacifica and Napa Series Systems to design shower enclosures. The sliding shower systems have pre-drawn templates in both 180-degree, in-line, and 90-degree, square, configurations for simple shower creation.

888/295-4531 | FHC-USA.COM

Software *(not pictured)*

Graphisoft announced a new global Software Service Agreement program for Archicad users, Graphisoft Forward. Available immediately with Archicad 25, Graphisoft Forward maximizes value and productivity while lowering the overall cost of software ownership through exclusive tools, training, support and services. With the program, users get updates as they become available without paying extra. The program also allows for volume discounts, preferential pricing, and free or reduced admission to events. 617/485-4202 | GRAPHISOFT.COM

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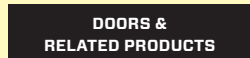
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Industry Spotlight profiles people across the glass and glazing industry, showing off the work of individuals while demonstrating the range of exciting careers in glass. To suggest someone to profile, write to Associate Editor Norah Dick, ndick@glass.org.

BUILDING CAPACITY: A CONVERSATION WITH GLAS-PRO

As demonstrated in the Top Glass Fabricators report, located on pages 40-57, fabricators have been busy this last year; busy investing in their businesses and innovating products. Top Glass Fabricator Glas-Pro, a custom fabricator based in Santa Fe Springs, California, is no exception to this.

I sat down with Joe Green, president of the company, to talk through workforce development, product innovation, and how building trends might be changing.

Q What has been your experience with hiring and training during this time?

Well, certainly hiring people has been a challenge, so what we've been trying to do is buy additional equipment that reduces the need for head count, and spend a lot of time training the people that we have. We're utilizing the advancements in technology and in material-handling, and bringing the employees that we have up to speed to be able to utilize that.

Our training involves how to operate the equipment, and really essentially, how to think about a particular task—how we organize the particular custom project that we're working on at that time. That's a constant challenge, because we're not making 4-by-4 XL windows all day long; everything we're doing is custom, so the real training is in the how, in addition to what, employees are doing.



The Diocese of Orange Christ Cathedral - Our Lady of La Vang Shrine., in Garden Grove, California. Glas-Pro supplied the custom-fabricated glass panels, part of the roof over the central statue of the Virgin Mary.

Q What kind of capital investments have you made recently?

We've added an additional tempering furnace, an additional laminating line, and an additional autoclave, which brings us up to four autoclaves. We also added an additional, very large, vertical CNC, and automated our back paint line to some degree. We've also bought some new trucks.

We've really been trying to use this time to try to build the company out because business itself has been level, and we've been trying to use this as an opportunity to increase our capacity.

Q What kind of products are customers asking for?

We spent the last 3-4 years developing bird-safe glass, the demand for which we continue to see grow as those codes change across the country, requiring bird glass. We're highly invested in all the bird glass type of materials, including transparent glass, with no frit pattern. People tend to want

glass as transparent as possible, and don't want to look at a storefront with patterns on it.

Our research and development has focused on increasing the transparency of the material even further. We are anticipating and planning for a growth in that area.

Q What other product or building trends do you see?

I'm interested to see what happens as offices [and workplaces] shift. What does that mean for tenant improvement, and what is that going to look like? Are people going to work in an office, or are we [in the industry] going to be doing smaller jobs to build out people's home offices?

The big tech [companies] are still building spaces and campuses, but the one thing the pandemic is shifting is how we live—I don't know how we're going to react to that at this moment. Our motto at Glas-Pro is, we're going to stay flexible. ■



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