KURARAY CO., LTD.

Management Briefing

Growth Opportunities of SentryGlas®

Presenters:

Hitoshi Kawahara	President and Representative Director
Tomoyuki Watanabe	Director and Managing Executive Officer President of Vinyl Acetate Resin Company President of Vinyl Acetate Film Company Officer Responsible for Electronics Materials Promotion Division
Stephen Cox	Executive Officer General Manager of Advanced Interlayer Solutions Division
Jennifer Schneider	Global Product Manager of Advanced Interlayer Solutions Division

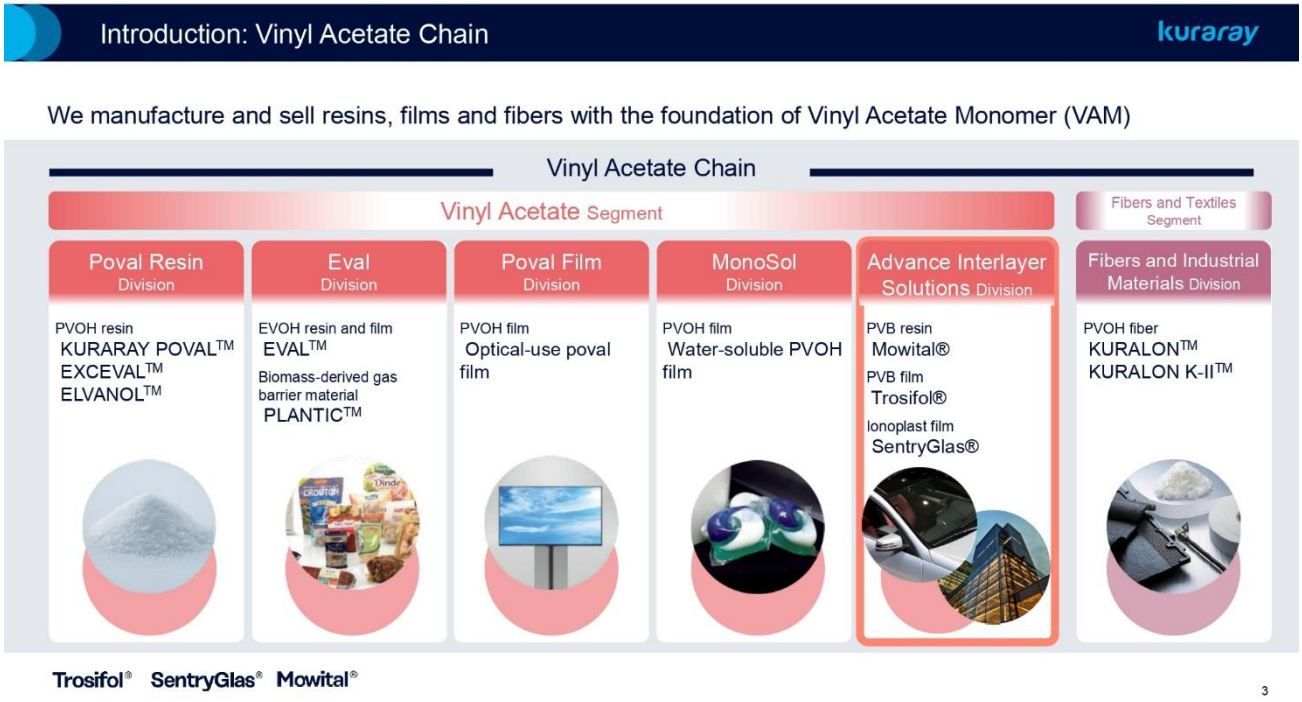


Kawahara: I'm Kawahara, President and Representative Director. Thank you very much for attending Kuraray management briefing.

Today, I'd like to introduce SentryGlas® that utilizes ionomer as a raw material in its filmmaking. It is handled in Advanced Interlayer Solutions division, a part of the Vinyl Acetate segment. We would like to introduce the strength and growth opportunities of the business.

We have two presenters from the U.S., Stephen Cox, Executive Officer and General Manager of its division, and also Jennifer Schneider, Global Product Manager.

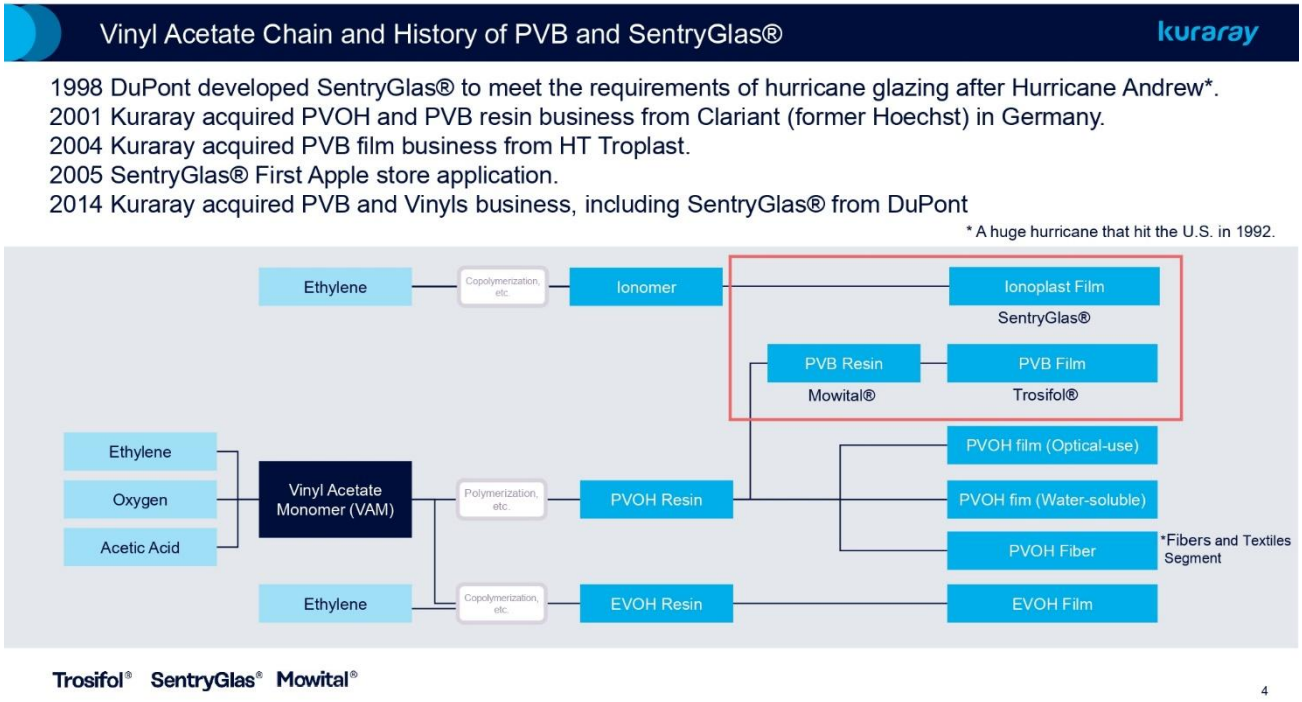
Before their presentation, I'd like to explain the positioning of advanced interlayer solutions business and its progress to date.



This shows our vinyl acetate chain. The raw material is the vinyl acetate monomer or VAM in short.

Starting from VAM, we have the poval resin business, and from there we produce a wide range of products such as films and fibers. In terms of the segment, most of our business belong to Vinyl Acetate segment, with some belonging to the Fibers and Textile segment.

SentryGlas®, the topic of today's briefing is under Advanced Interlayer Solutions division. SentryGlas® is a part of the portfolio along with Mowital®, PVB resin, or Trosifol®, PVB film.



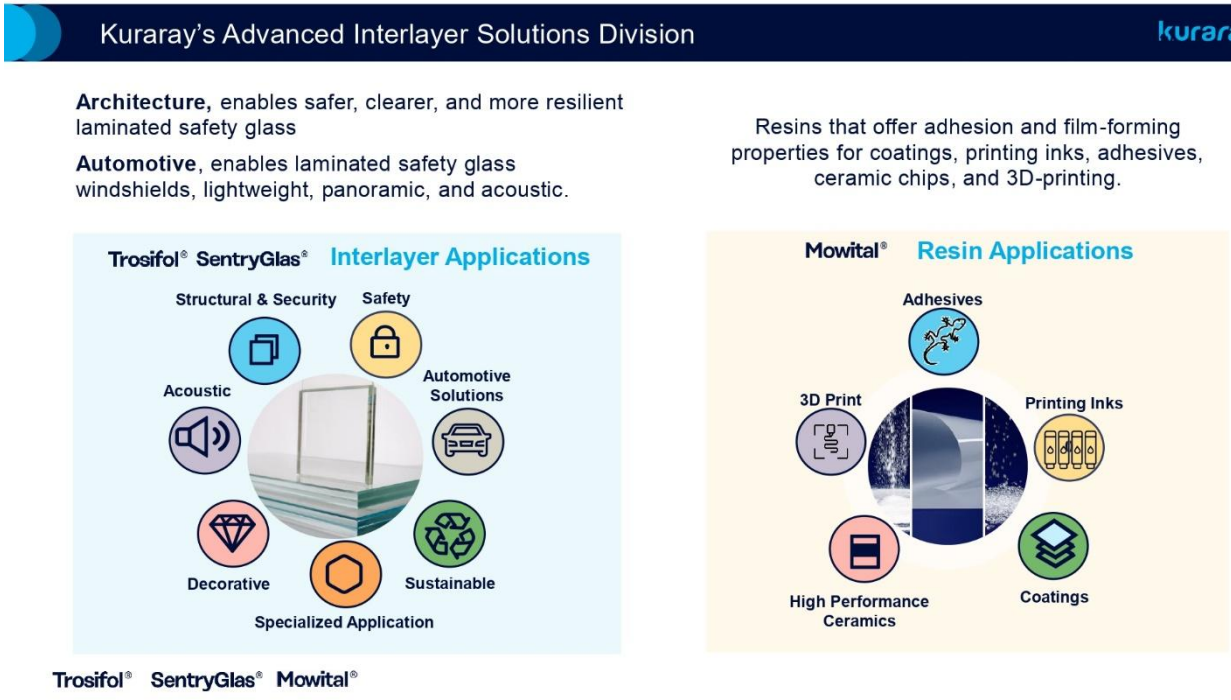
You see the manufacturing process overview of the vinyl acetate-related products, and history of PVB and SentryGlas®. PVB resin, PVB film and SentryGlas® under Advanced Interlayer Solutions division are written on upper right in the red box.

Since the 2000s, we have been actively pursuing M&A in the peripheral area to strengthen our mainstay vinyl acetate-related business. The Advanced Interlayer Solutions division was born through several business acquisitions as part of the series of mergers and acquisition.

In 2001, we acquired the PVOH and PVB resin businesses of Clariant of Switzerland (formerly Hoechst) in Germany. In 2004, we acquired PVB film business of HT Troplast in Germany. And, in 2014, we have bought PVB film business as well as the SentryGlas®, ionomer sheet business of DuPont in the U.S.

SentryGlas® was developed by DuPont in 1998 in response to Hurricane Andrew, which struck the U.S. state of Florida in 1992. It has high strength and transparency, and its use in well-designed buildings and facades has expanded in recent years, including its use in the Apple Store in 2005. This is one of the businesses expected to grow in the future.

As for the further details about the business as well as the growth opportunity, Steve Cox will deliver.



Cox: I'll give you a quick overview of the division, what's in the division, and talk first about PVB.

PVB film, sometimes we call it interlayer, sometimes we call it film. Interlayer means it's between glass and glass, and it's in the middle. With PVB, we have two major market segments: architectural, meaning buildings, and automotive, mainly windshields.

On the right of this chart, you see the resin business. Traditionally, it's paint coatings, adhesives. More increasingly now, we're getting into ceramic chips. That's the future business for the resin.



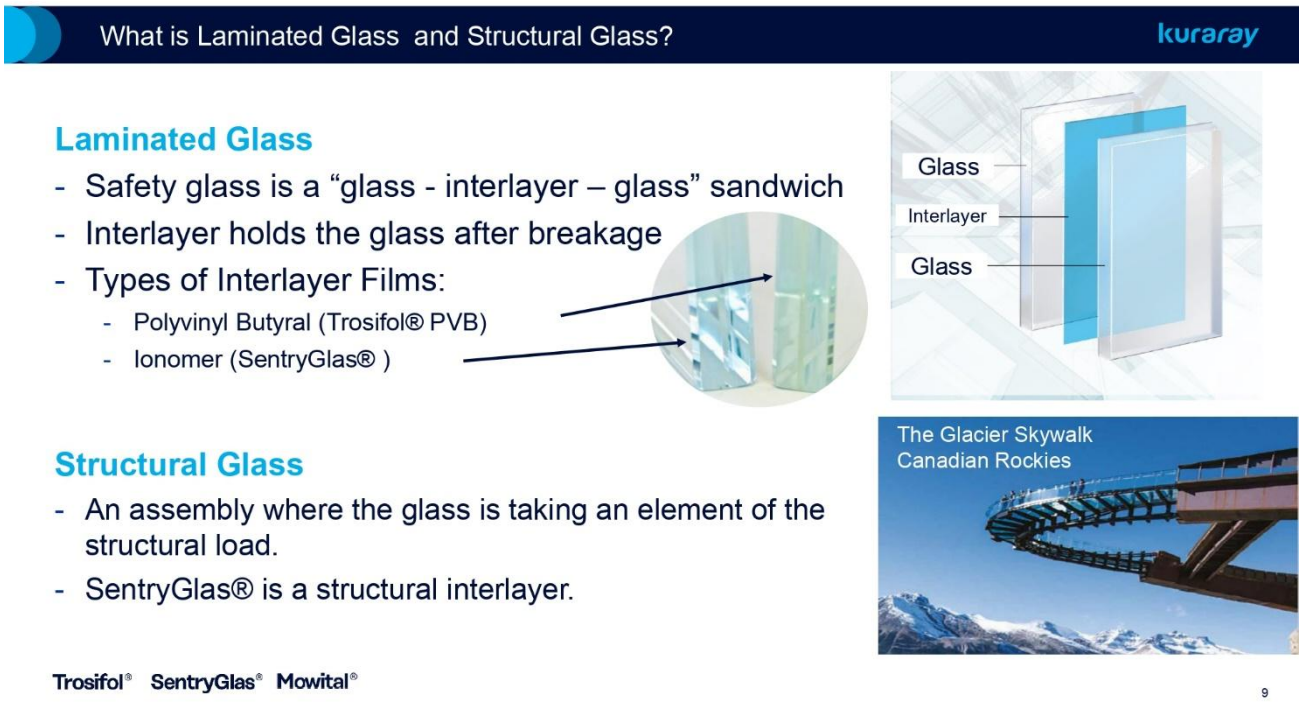
We're really operating all across the world. Both I and Jennifer were formerly DuPont. The headquarters of the Advanced Interlayer Solutions division is in the U.S., in Wilmington. We have six production facilities and two R&D centers. We have sales offices, and we supply every continent, a big business in Western Europe, North America, and a good business in Asia and South America.



What we're going to show now is a quick video, a two-minute video.

It was produced by DuPont before the business was acquired by Kuraray. It shows the origin of the technology and the basic idea, which was invented by DuPont. It also shows there's a big ball that swings and breaks glass, and it shows the three different stages or improvements of safety glass. The first safety glass is tempered glass, which is heat-treated to prevent lacerations. Then there's PVB, which is better safety glass, and then finally, it shows SentryGlas®.

I'm going to hand over to Jennifer now, who's going to talk some technical properties of the product.



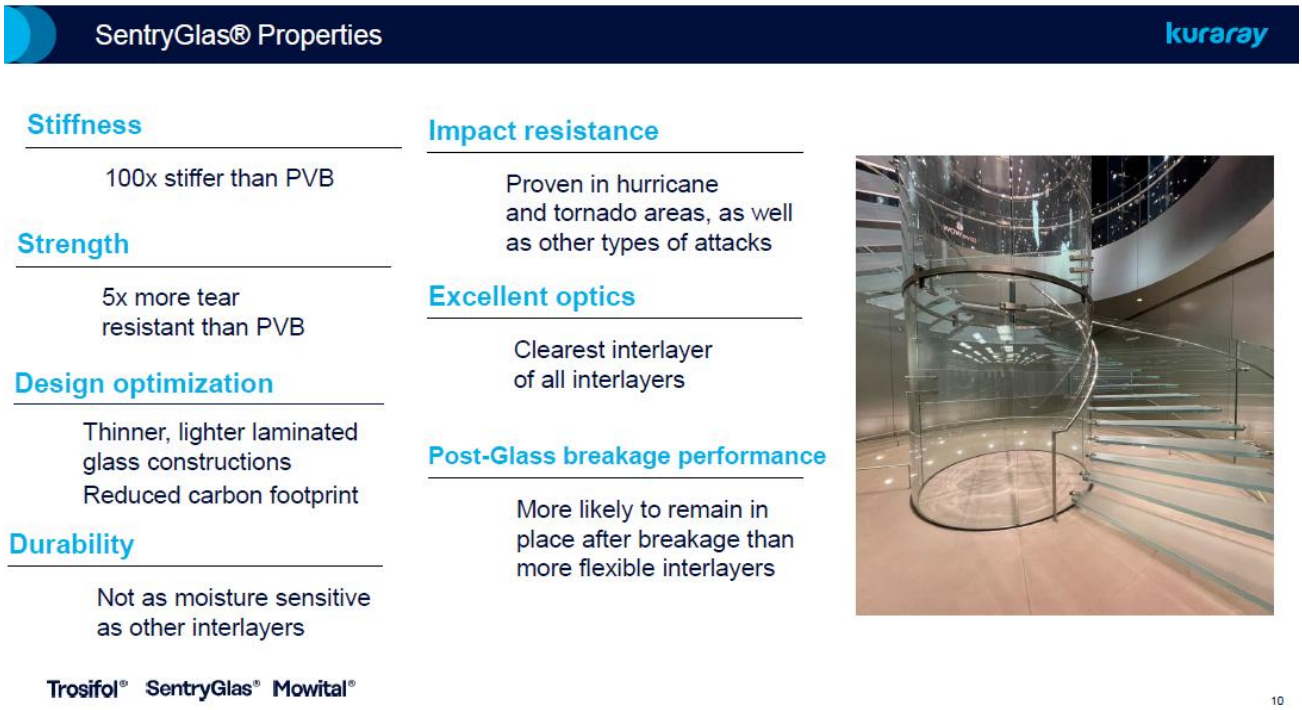
Schneider: You saw in the video really good example of the performance of different types of glass. I'm going to go into a little bit more detail in describing what these different types of glass are structurally.

You have Laminated Glass, which is basically two pieces of glass with an interlayer in between. The purpose of the interlayer is to hold the glass in place after it's broken. This increases the safety over standard tempered glass.

There are two main types of interlayers that are used in the market today, and the one is PVB. This has been around since the 1930s. It's what you look at every day if you drive a car. More recently, the newer development in interlayers is SentryGlas®, which was developed 27 years ago.

I want to highlight two key differences in the appearance of the PVB and the SentryGlas®. You can see the diagram there shows that the PVB is more yellow, and the SentryGlas® is less yellow. This is very much a feature that is desired by architects and engineers that are designing buildings where they want to have open edge, and they want to use low-iron glass (high transparency glass with iron removed), which is more costly, and they want to have a good appearance.

Structural Glass is a laminated glass with even greater safety features. By using SentryGlas®, glass can be used as a structural element of a building, like wood or stone. It can also be used for large glass panes, and its high strength enhances its performance after glass breakage. The Glacier Skywalk in the Canadian Rocky Mountains, shown in the photo at right, is an example of SentryGlas® used as structural glass.



SentryGlas® has some many unique properties that differentiate it from PVB.

First, it is 100 times stiffer than PVB. Strength, five times more tear-resistant than PVB. It can hold a window in place much better than PVB when it's being impacted by wind or debris.

The stiffness and the strength combined lead to better design optimization. There are two things that you benefit from that. One, you can make the glass thinner, which makes the glass lighter, and you can use less metal attachments, which reduces the carbon footprint of the total building. In addition, you can design glass to be much bigger, and it can carry a much bigger load. Architects love this because it allows them to design iconic buildings that have just breathtaking facades.

The durability is much better than PVB as it is not as moisture-sensitive. This means that it can be used in open-edge applications. PVB in an open-edge, moisture intrusion will come in and cause delamination and also clouding, and it doesn't look very good. SentryGlas® does not change its appearance over time. Again, this makes it desirable in balustrades and railings, where people want to sit and look out at the ocean, and not have a metal piece on top of the railing, unobstructed views of the scenery.

Impact resistance is an important property in the hurricane market and tornado, areas as well as other types of attacks. Anything where the glass is being impacted, whether it be from a bomb, from a bullet, from debris, it has much better impact resistance in PVB.

Again, excellent optics. I think I touched on this already with the low yellowness. Of any interlayer in the market, it is the clearest interlayer of all interlayers.

Last but not least, the post-glass breakage performance is unlike any other interlayer that is available today on the market. That allows you to design things such as this Apple Store, which is located in New York City. You can see the glass steps that are open-edge and also are able to bear the load of someone walking up the stairs. It creates a very visually appealing environment.



This slide shows the various applications where SentryGlas® is used. I'm going to talk about each one individually. The first one and the very first applications for SentryGlas® is an example of a hurricane application. This building was built using SentryGlas® as well as other mitigation building components. The area was hit by a hurricane, and you can see it's the house that's still standing. SentryGlas®' impact strength allows it to meet the highest requirements of large missile impact in the hurricane region around the world.

The next is facades. This is the Shanghai Tower. Here, the properties of glass stiffness up to 50 degrees Celsius and less deflection under load allowed thinner glass, less metal support, and a lower carbon footprint. This building needed to be designed to be able to withstand high wind loads as well. The strength of SentryGlas® enabled the use of more glass.

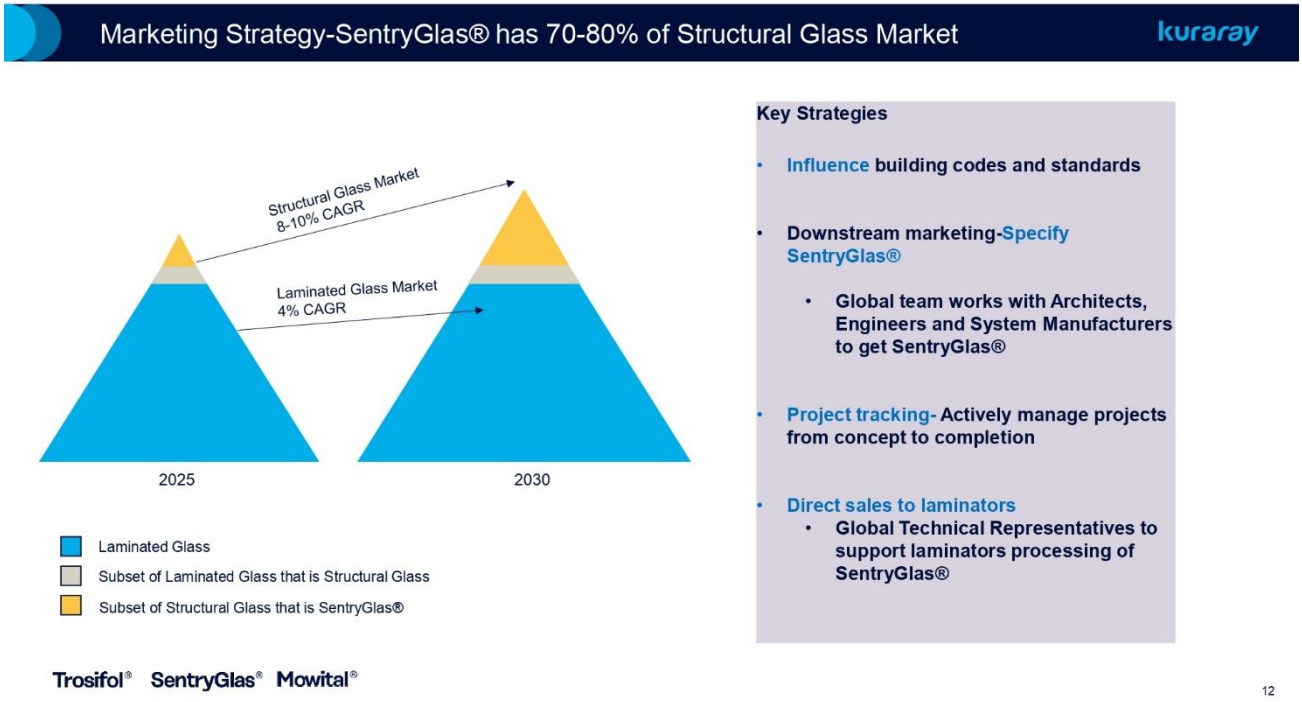
The next is the King Power building in Bangkok. Edge clarity and post-breakage strength are important. You can see there's a railing there, which you can hardly see because it's open edge and there's no metal.

The next is the American Dream, which is in New Jersey. On to overhead glazing, again, where post-breakage strength is also important, as well as stiffness up to 50 degrees Celsius and less deflection under load.

Bottom row, far left, is a high-security buildings. This is where SentryGlas® has an advantage over PVB, which is used most commonly, in that it is more durable. Also, the impact performance and toughness allow it to meet the highest bomb blast requirements prescribed by the U. S. Department of State as well as bullet-resisting requirements.

The next is the Willis Tower in Chicago. This used to be called the Sears Tower. Here is an example where, obviously, post-breaker strength is important. You get a chance to come to Chicago, I recommend coming out and taking a look. It's really quite amazing.

The next is Iona Sky Dome, an example of marine glazing. Again, because of the strength of SentryGlas®, you can lightweight the glass, which is very important in boats. Also, the open edge durability, as you are out in the ocean, your edges will not become cloudy or distorted like PVB will.

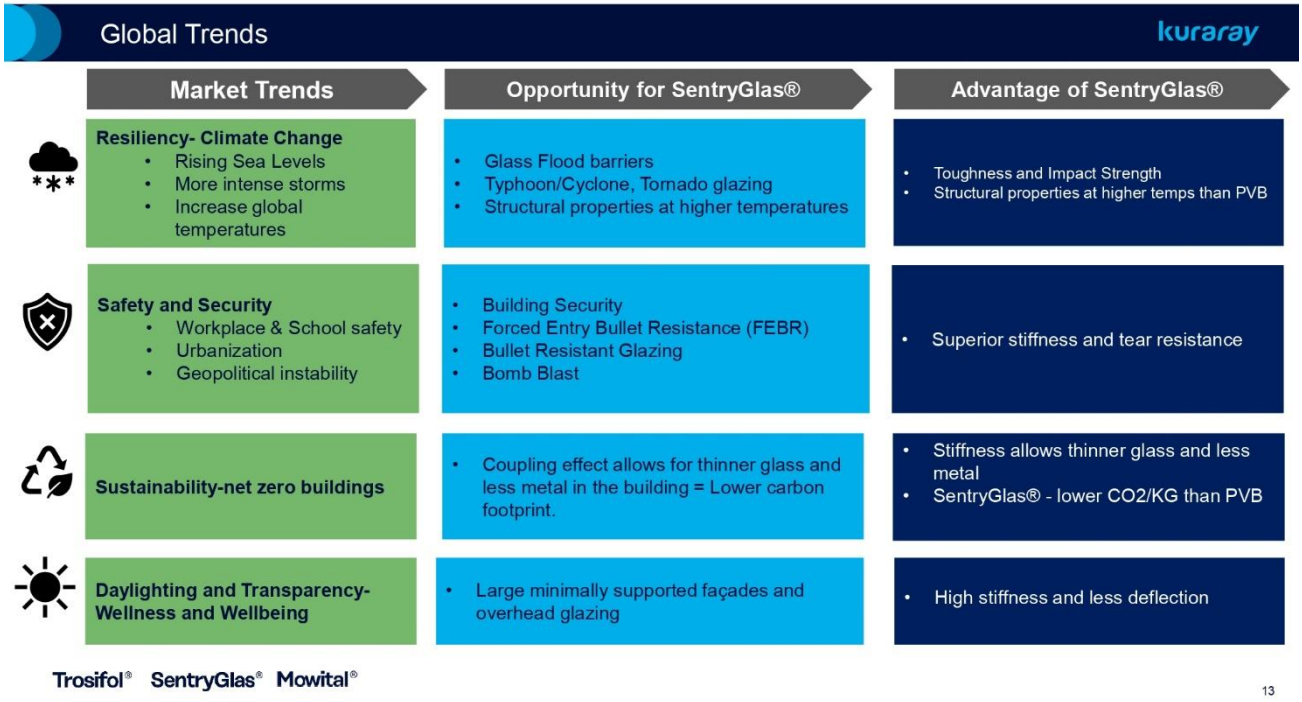


Cox: There's two pyramid charts on the left. The total pyramid is the laminated glass market. Of that, the orange and the gray part are the structural glass market. Within that structural glass segment, the orange is our business. We have 70% to 80% market share of structural glass, and we are the market leader.

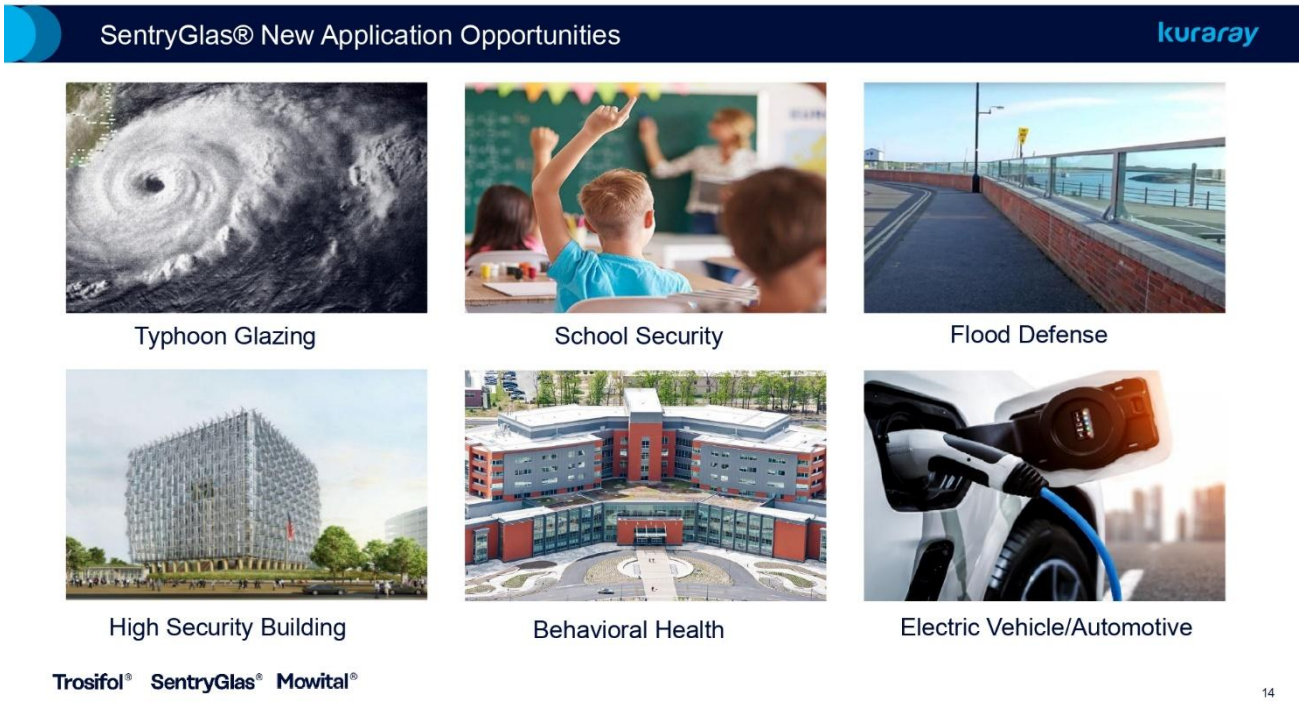
The laminated glass market is expected to grow annually at about 4%, whereas the structural glass market will grow about twice as fast, 8% to 10%. It's an attractive, high-value, high-performance segment of a small segment in the total business.

Just briefly, our strategies, the things that we do with the business. We talk to governments and regulators about getting codes and standards to specify SentryGlas®. We do what we call downstream marketing, which is a lot of work with architects and engineers, so that they're aware of the features and the benefits, and they can put the specification requiring SentryGlas® into the design for a building.

Then we track projects. Projects that are global and span multiple years are subject to delays and budget overruns. We track projects through to completion, and if, for example, a change from SentryGlas® to PVB is being considered due to budget cuts, we communicate and encourage the use of SentryGlas®. Also, we have technical service people and support labs, support functions all around the world to support the laminators who are our direct customers.



On the left are really the market trends or the megatrends going on in the world. The light blue in the middle are the opportunities that this creates for SentryGlas®. Then the dark blue on the right are the specific advantages that we can offer with SentryGlas®. This is about the future where we're confident of future growth in the business.



These are examples of new application opportunities of SentryGlas®.

The origin of the business was the hurricane market in Florida. With the large number of typhoons in the Asia-Pacific region, we believe that there is a great opportunity for growth in typhoon-resistant glass.

On the right side of that is school security. Although very frightening, there have been school shootings in various parts of North America and the world. It is unfortunate, but school security needs to be strengthened.

On the top right, flood defense, embankment. The top can be made of glass to create an attractive design. There's other examples of flood defense, which can be the first story of a building, residential or commercial, that's in a flood zone. The doors and the windows are the weak areas that need to withstand the pressure of the water, and SentryGlas® can offer a solution for that.

Bottom left is an example of high-security building. This is the U.S. Embassy in London. We're using the 20 to 30 years' experience we have with U.S. government buildings and their specifications. We're using that pedigree to begin to talk to other Western governments. They're building embassies and different buildings and renovations as well. There's a great opportunity there for us.

The picture next to it, which says Behavioral Health, is a psychiatric hospital. While windows are important for lighting, they also need to be strong for safety. With SentryGlas®, it is possible to create a design that satisfies both requirements.

The bottom right is electric vehicles and automotive. SentryGlas® doesn't get used in the front windshield. It's too stiff, actually. But increasingly, we're looking to offer it for glazing side glass and also roof systems. With electric vehicles, where the batteries are on the floor, and the cabin space is reduced, they're trying to reduce thickness of the roof, and the OEM automotive companies want design features. They want the big roof systems and display and strength, and SentryGlas® can offer lightweight and good solutions.



We'll end with one video. It celebrated 25 years of SentryGlas®, which was actually two years ago. We've more than doubled the business under the management of Kuraray.

That completes the presentation.