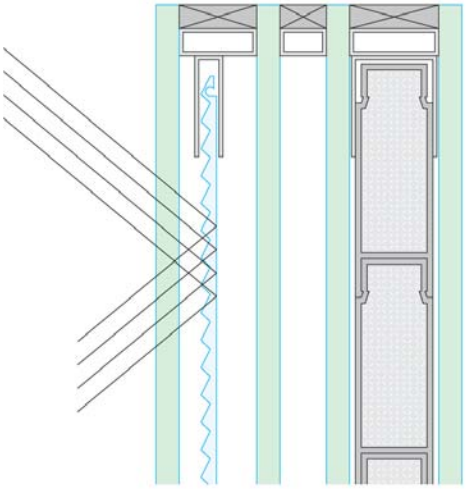
GLASSX

Innovative Thermal Management & Daylight Design Opportunities
For the Sustainable Building Glass Envelope

Utilizing Crystalline PCM (Phase Change Material) Thermal Storage Cells,
and reflective DLS Prism Technology



GLASSX FEATURE AND BENEFIT OVERVIEW

Innovative Thermal Management & Daylight Design Opportunities

Feature: High Capacity Latent Heat Storage Module

What differentiates GlassX from all any other forms of wall construction, is its utilization of the Crystalline PCM (Phase Change Material) to absorb, store and release thermal energy. The GlassX PCM melts and freezes in the temperature range of between 79 to 86 degrees F (26-30 degrees C).

Benefit: ***Ingenious Passive Energy Storage***

The GlassX PCM is a *passive* energy storage system that works by storing solar gains hitting the building envelope as such gains reach over 24, 26 or 30 degrees C. Presented with intense or sustained solar gains, the PCM will slowly melt as it collects and stores this energy over a 12 to 16 hour period. As temperatures fall during the evening, the PCM will "recharge" and re-crystallize by morning to be ready to collect and store solar gains once again. This simple but ingenious approach to managing solar gains is a complete end-to-end system for glass curtain walls and windows, and goes a long way to reducing costs for building energy usage.

During winter months, the PCM combined with R12 insulation, effectively create a "solar tile stove" (the PCM collects more solar gains than thermal losses) on the inner side of the glass façade. Designs using GlassX can provide winter heating load reductions of 150 – 200 kWh / m² per year.

Benefit: ***Save Energy and Go Green with GlassX PCM***

The greater storage capacity provided by GlassX reduces dependencies on HVAC systems, offering a much more "green" and environmentally friendly option for design by reducing heating and cooling requirements, thereby slashing energy costs by between 30 to 50%. *

Benefit: ***Never Sacrifice on Curtain Wall Design***

GlassX is a quantum leap forward for building envelope design and thermal management interfaces, using the innovative PCM to achieve new thermal control capabilities without sacrificing glazing unit maximum widths.

The PCM's significant storage capacity comes with no design constraints or strings attached, providing designers with more options while reducing insulation requirements.

Feature: Thin Latent Heat Storage Module

GlassX's crystalline PCM design provides significant thermal storage capacity at a constant temperature with minimal physical footprint / thickness.

Benefit: ***Vastly Improved Daytime and Nighttime Thermal Management***

Latent heat storage is a very important consideration in building envelope design. In the summer, the PCM will absorb as much heat as a nine-inch (24 cm) layer of concrete, however, it will not begin radiating heat into the interior space until it has reached its maximum thermal storage capacity. This process happens much more slowly than in all other forms of wall construction, resulting in vastly superior thermal management performance by GlassX.

Due to the PCM, heat will not begin being released until after 12 to 16 hours of absorption, providing designers with much greater heat storage capacity. This 12 to 16 hour period is longer than a regular daytime cycle. This is key to GlassX's superior performance, as by the time the PCM's storage capacity is reached, nighttime cooling will off set the higher daytime temperatures with lower nighttime temperatures. GlassX accomplishes this with three-inch wall construction, rather than nine-inch or greater wall construction.

Feature: Reflective GlassX Prism Module

The GlassX Prism Module reflects solar gains at higher altitudes in the summer, which is over 40 degrees, and transmits solar gains at altitudes below 35 degrees in the winter.

Benefit: **All Season Energy Savings**

In the summer, the GlassX Prism Module will maximize the heat energy reflected by the prism, thereby minimizing solar gains and extending the PCM thermal storage capacity. Conversely, in the winter, the prism will minimize the heat energy reflected by the prism, thereby maximizing solar gains and making the most of the PCM thermal storage capacity.

What results is a thermal storage management system that is highly effective in both summer and winter conditions. This is accomplished in a passive way by the genius in design, and requires no electrical or mechanical components or any other form of seasonal maintenance.

Feature: PCM Performance Lifecycle

GlassX provides performance guarantees of consistent thermal storage capacities for the lifecycle of the PCM.

Benefit: **An Interface to Outlast the Envelope**

GlassX PCM retains effectiveness for almost 100 years of phase changes (6000 total cycles with approximately 60 cycles per year), reducing the Total-Cost-of-Ownership when compared to other materials that may fail or require costly maintenance.

Benefit: **Guaranteed Reliability**

GlassX is a robust and reliable interface that gives designers and contractors the confidence to stand behind GlassX installation. The PCM's polycarbonate components are welded by ultrasonic sound and become one solid element, and the borders of the glass are held together with butyl for extra durability. With PCM lifecycle guarantees and industrial construction, GlassX provides designers, builders, and owners with the satisfaction of making a lasting investment in this effective interface technology that will pay dividends.

Feature: High Indoor Natural Light Transmittance

GlassX PCM allows the majority of natural external sunlight in the visible spectrum (from 380 to 780 nanometers) to be transmitted through the glass.

Benefit: **Increased Lighting Design Flexibility**

GlassX provides increased design flexibility and innovative options for natural lighting while meeting high U-Value requirements. A combination of the use of high natural light transmittance material, along with thermal management capabilities, provides new ways of thinking about lighting in design. GlassX also saves on artificial lighting costs by providing more consistent natural lighting capabilities when compared to almost all other R19 building materials. In fact, direct-beam light transmission is up to 45% when the PCM is in liquid form and up to 28% when the PCM has crystallized.

Benefit: **Providing Occupants with Increased Natural Lighting Benefits**

The high light transmittance value of GlassX will not limit incoming natural lighting, ensuring a more pleasing aesthetic experience for building users, by increasing soft translucent natural light each and every day and year round.

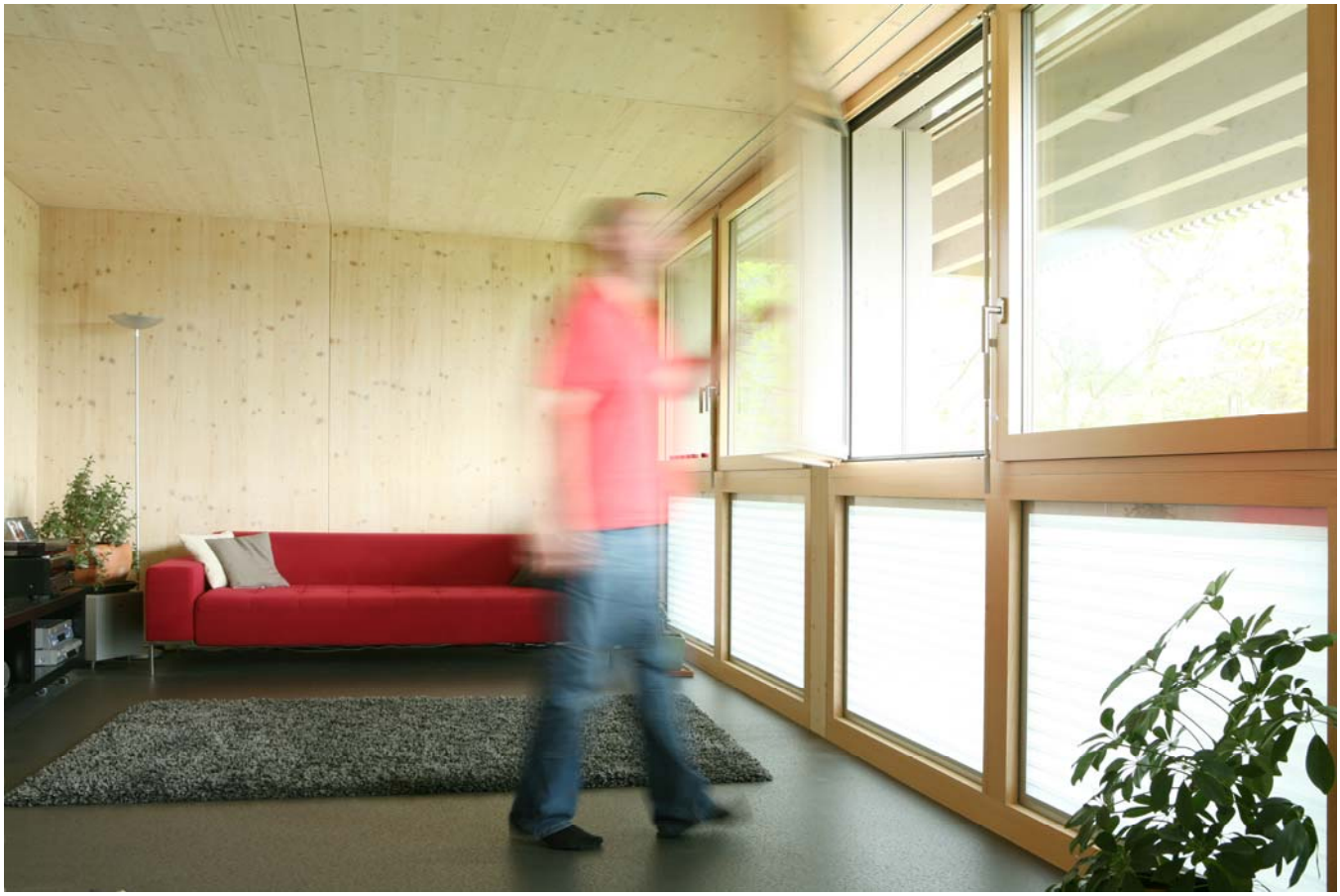
Natural lighting is associated with a broad range of benefits, including but not limited to increased employee productivity, increased retail sales, and even treatment of S.A.D. (Seasonal Affective Disorder) with the provision of 10,000 LUX of natural sunlight. GlassX assists in making building interiors more beautiful, productive, and environmentally friendly.

Feature: ***Glass Décor Possibilities***

GlassX can handle ceramic screen patterning or etching design (e.g. Sandblast or acid) for patterns or designs to enhance aesthetic appearance and design opportunities.

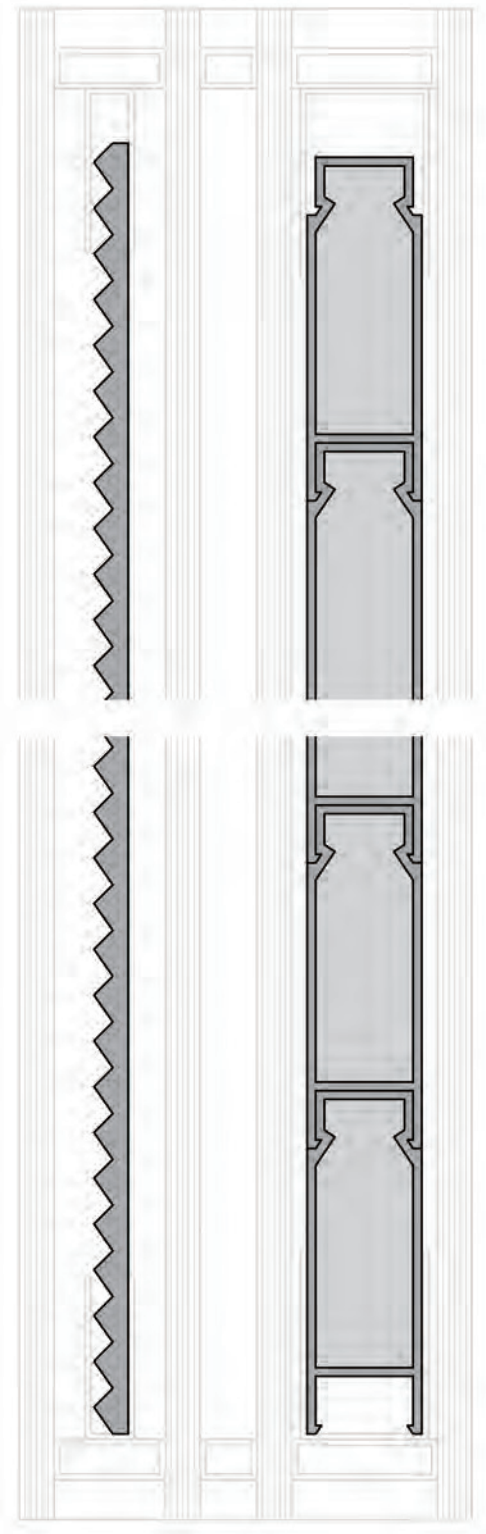
Benefit: **Virtually Unlimited Aesthetic Design**

GlassX enables a full range of aesthetic design possibilities, including optional ceramic frit, patterned décor glass or frosted etching design (e.g. Sandblast or acid) on the interior surface of GlassX, without sacrificing U-Values or significantly affecting light transmittance.



GLASSX®crystal - technical data

Glass 1 exterior	Tempered safety glass
Gap between panes 1	Gap between panes with prism plate and inert gas
Glass 2	Tempered safety glass with Low-E
Gap between panes 2	Gap between panes with inert gas
Glass 3	Tempered safety glass with Low-E
Gap between panes 3	Gap between panes with PCM-plate
Glass 4 interior	clear Floatglas, optional with ceramic screenprint*



Element thickness	62 - 86 mm
Thickness tolerance	-1/+4 mm
Fold width	67 - 96 mm
Weight	max. 95 kg/m²
Max. surface area	6,0 m²
Max. hight	3000 mm
Max. width	2000 mm
Heat transmission coeccicient (U-value)	up to 0,48 W/m²K
Light transmission	
for crystalline PCM	8 - 28 % (± 3 %)
for fluid PCM	12 - 44 % (± 4 %)
Total energy transfer ratio (g-value):	
vertical direct irradiation	
for crystalline PCM	33 % (± 4 %)
for fluid PCM	37 % (± 4 %)
diffuse irradiation	29 %
seasonal winter months	
for crystalline PCM	33 %
for fluid PCM	35 %
seasonal summer months	
for crystalline PCM	6 %
for fluid PCM	9 %
Storage capacity	1185 Wh/m²
Storage temperature	26 - 28 °C

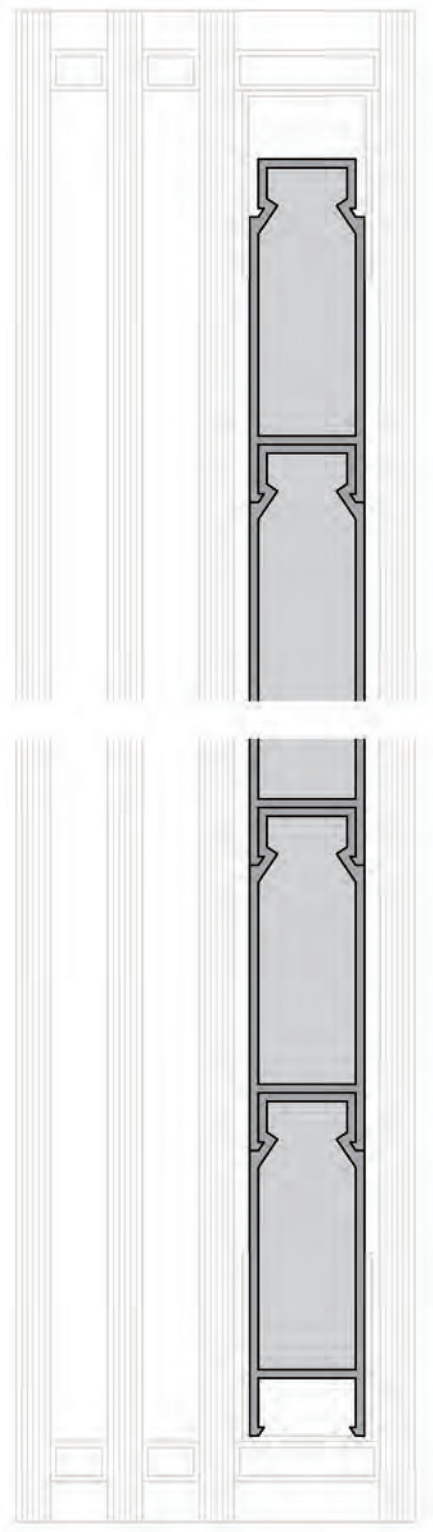
* completion as safety glass

The specifications U-value, light transmission and g-value are certificated by the "Fraunhofer Institut für Solare Energiesysteme".

GLASSX®comfort - technical data

Glass 1 exterior	Tempered safety glass
Gap between panes 1	Gap between panes with inert gas
Glass 2	Tempered safety glass with Low-E
Gap between panes 2	Gap between panes with inert gas
Glass 3	Tempered safety glass with Low-E
Gap between panes 3	Gap between panes with PCM-plate
Glass 4 interior	clear Floatglas, optional with ceramic screenprint*

Element thickness	52 - 72 mm
Thickness tolerance	-1/+4 mm
Fold width	57 - 82 mm
Weight	max. 92 kg/m²
Max. surface area	6,0 m²
Max. hight	3000 mm
Max. width	2000 mm
Heat transmission coeccicient (U-value)	up to 0,48 W/m²K
Light transmission	
for crystalline PCM	8 - 28 % (± 3 %)
for fluid PCM	12 - 44 % (± 4 %)
Total energy transfer ratio (g-value): vertical direct irradiation	
for crystalline PCM	33 % (± 4 %)
for fluid PCM	37 % (± 4 %)
Storage capacity	1185 Wh/m²
Storage temperature	26 - 28 °C



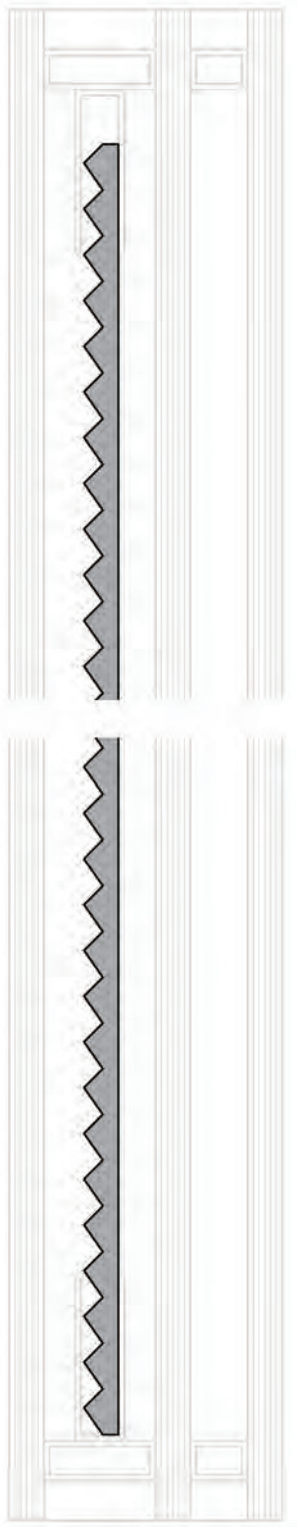
* completion as safety glass

The specifications U-value, light transmission and g-value are certificated by the "Fraunhofer Institut für Solare Energiesysteme".

GLASSX®prism - technical data

Glass 1 exterior	Tempered safety glass
Gap between panes 1	Gap between panes with prism plate and inert gas
Glass 2	Tempered safety glass with Low-E
Gap between panes 2	Gap between panes with inert gas
Glass 3 interior	Tempered safety glass with Low-E optional with ceramic screenprint

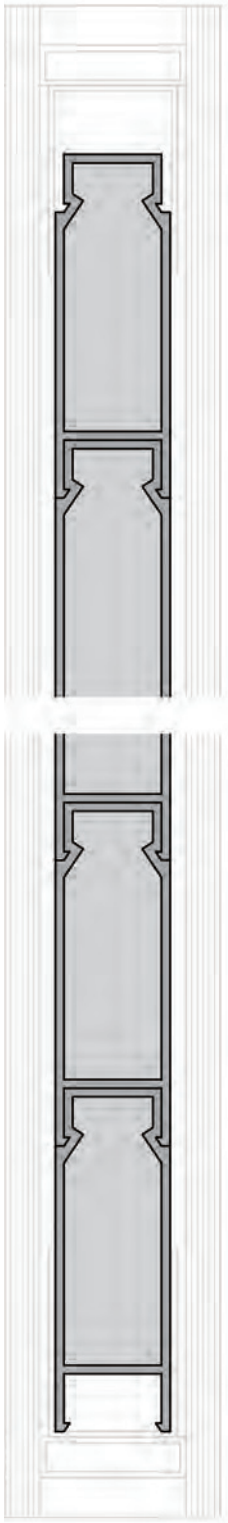
Element thickness	32 - 54 mm
Thickness tolerance	-1/+4 mm
Fold width	37 - 63 mm
Weight	max. 54 kg/m²
Max. surface area	6,0 m²
Max. hight	3000 mm
Max. width	2000 mm
Heat transmission coeccicient (U-value)	up to 0,48 W/m²K
Light transmission	up to 54 %
Total energy transfer ratio (g-value):	
vertical direct irradiation	44 % (± 5 %)
diffuse irradiation	29 %
seasonal winter months	41 %
seasonal summer months	12 %



The specifications U-value, light transmission and g-value are certificated by the "Fraunhofer Institut für Solare Energiesysteme".

GLASSX®store - technical data

Glass 1	Tempered safety glass
Gap between panes 1	Gap between panes with PCM-plate
Glass 2	Tempered safety glass optional with ceramic screenprint

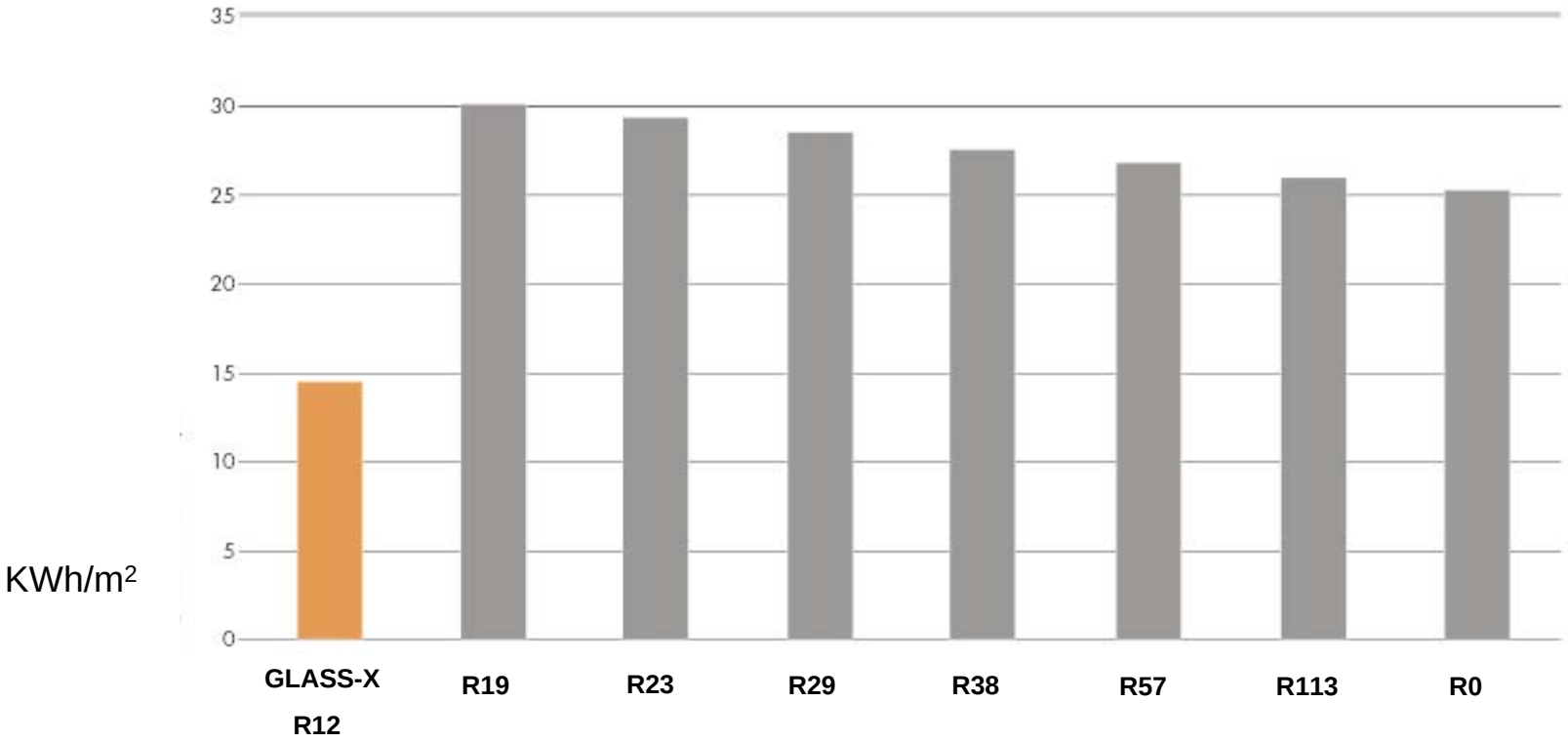


Element thickness	34 - 38 mm
Thickness tolerance	-1/+4 mm
Fold width	33 - 40 mm
Weight	max. 58 kg/m²
Max. surface area	6,0 m²
Max. hight	3000 mm
Max. width	2000 mm
Light transmission	
for crystalline PCM	0 - 38 % (± 3 %)
for fluid PCM	4 - 55 % (± 3 %)
Total energy transfer ratio (g-value):	
vertical direct irradiation	
for crystalline PCM	33 % (± 4 %)
for fluid PCM	37 % (± 4 %)
Storage capacity	1185 Wh/m²
Storage temperature	26 - 28°C

For interior use

The specification light transmission is certificated by the "Fraunhofer Institut für Solare Energiesysteme".

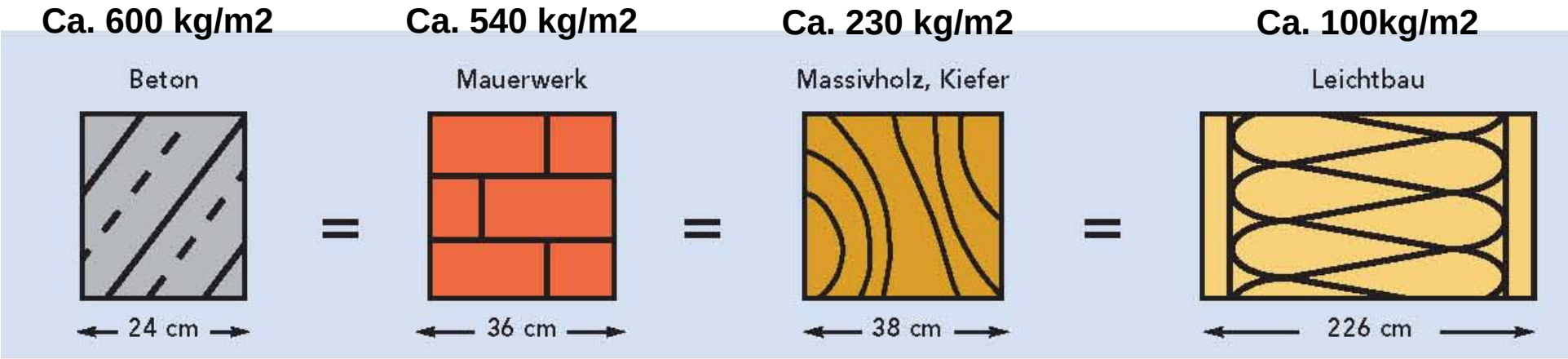
GLASSX-crystal Comparison to opaque wall construction, relating to the annual heating consumption



GLASS-X = U-value 0.08btu/F/ft2
= R-value 12

IGU = U-value 0.28btu/F/ft2
= R-value 3.5

Thermal mass, thickness and weight



Schichtdicke unterschiedlicher Materialien bei einer Wärmespeicherkapazität von 5700 kJ (Temperaturerhöhung um 10 °C).

Ca. 58 kg/m2

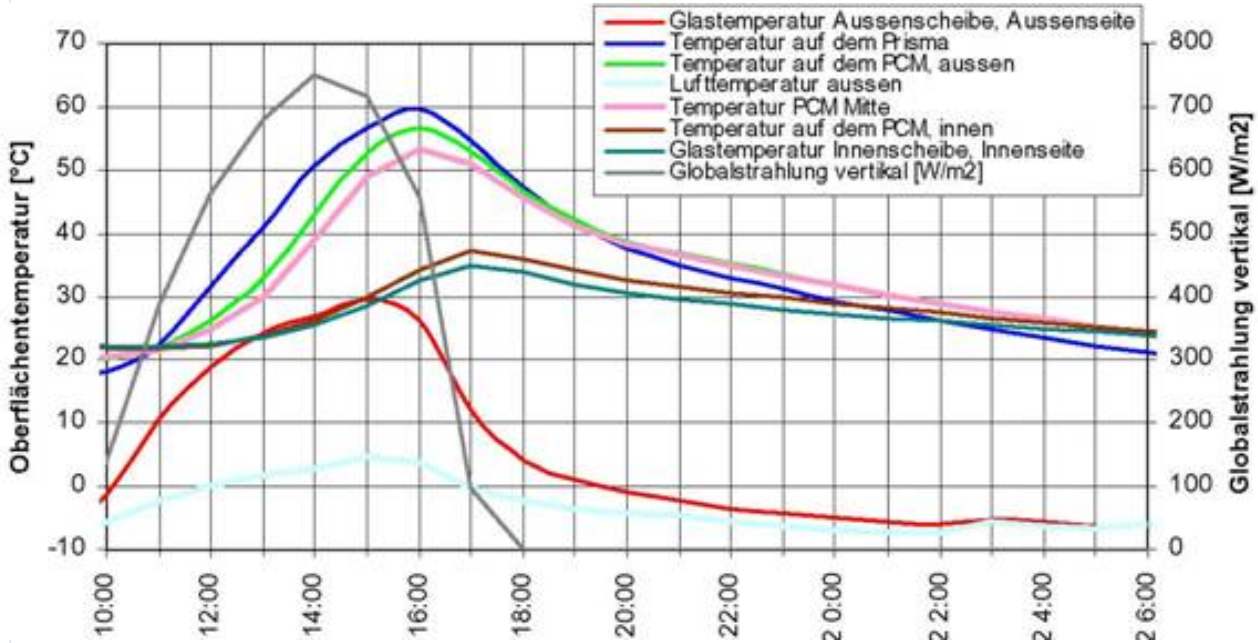
Latent heat storage module (PCM) =

GLASSX®comfort “store”

3,8 cm

GLASSX®crystal : Measurements taken at the building

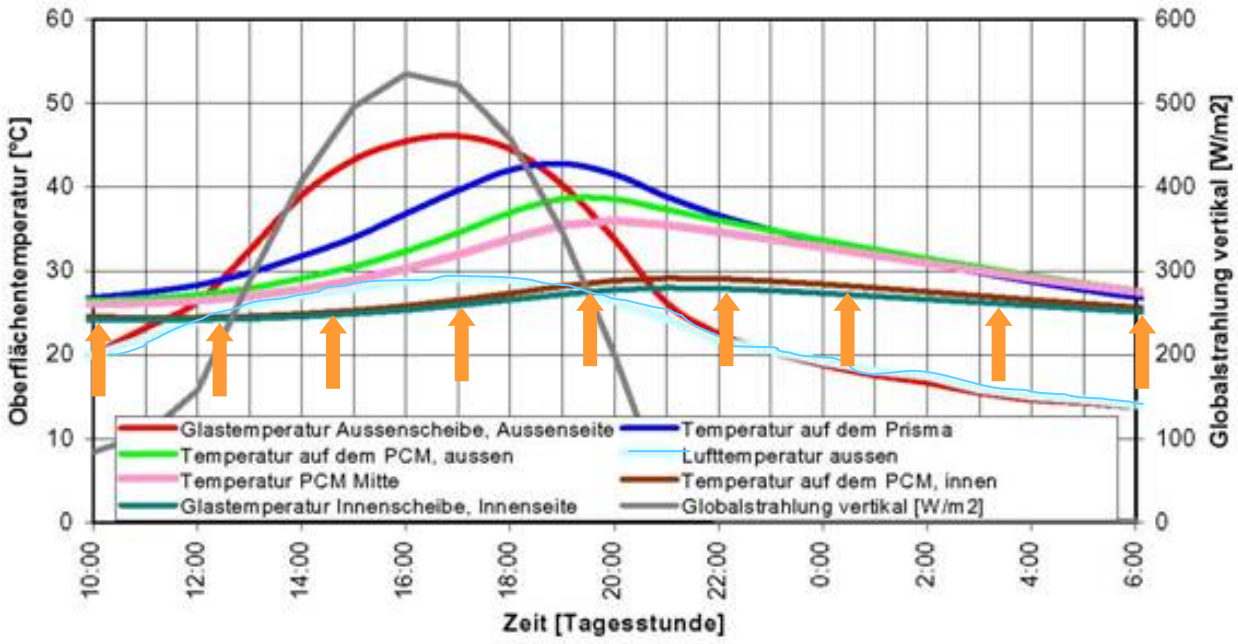
Winter	Low	time	Peak	time
Ambient air temperature	**- 8°C**	5:00 am	**+ 4°C**	3:00 pm
Inside pane temperature	**+ 23°C**	10:00 am	**+ 35°C**	5:00 pm



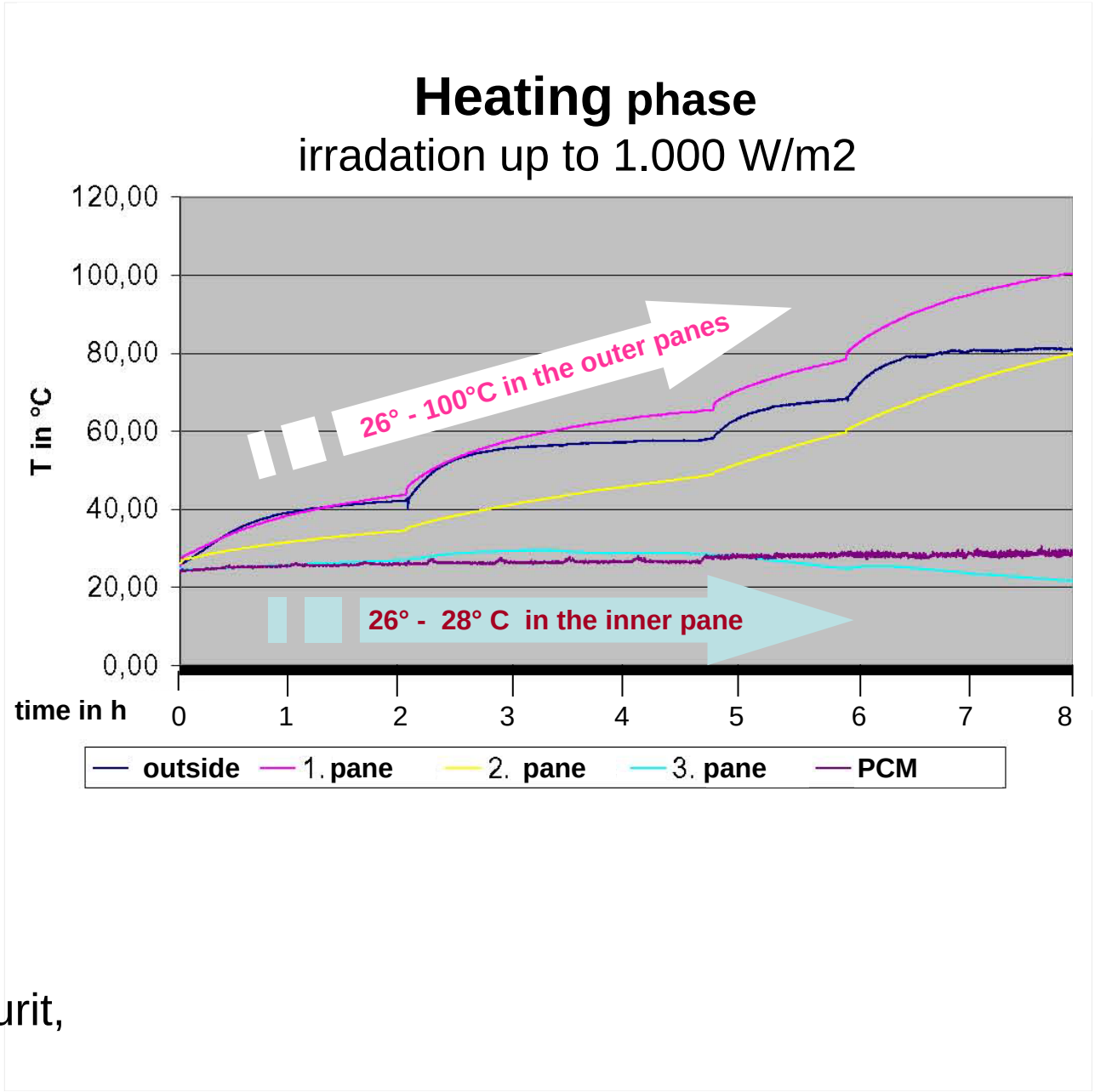
GLASSX®crystal

Measurements taken at the building

Summer	Peak	time	Low	time
Ambient air temperature	**+ 30°C**	5:00 pm	**+ 14°C**	6:00 am
Inside pane temperature	**+ 27°C**	9:00 pm	**+ 23°C**	6:00 am

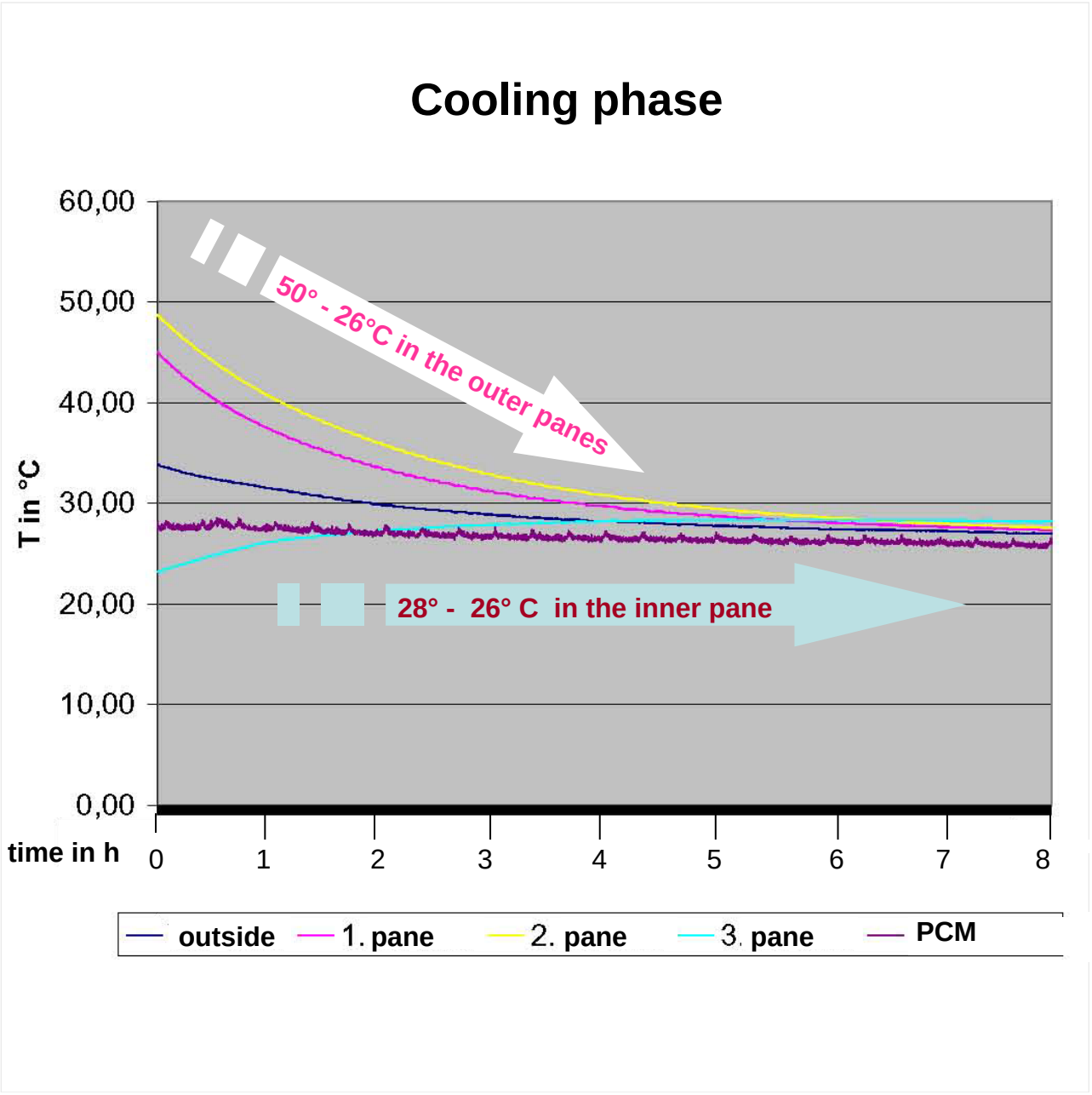


GLASSX®crystal



Measurement of the PCM
by R&D Saint Gobain Securit,
Herzogenrath

GLASSX®comfort

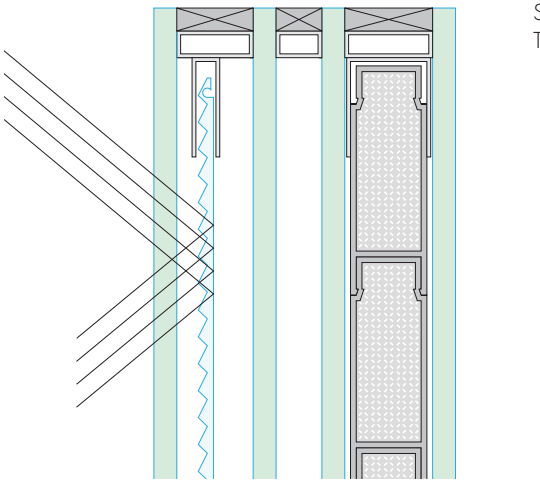


Measurement of the PCM
by R&D Saint Gobain Securit
Herzogenrath

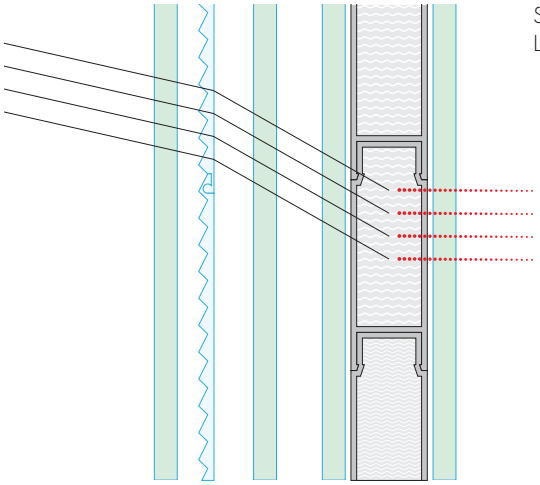
The GLASSX®crystal method of functioning

GLASSX®crystal integrates 4 system components in a functional unit:
transparent heat insulation, protection from overheating, energy conversion and thermal staroge.

A 3-ply insulating glass construction provides excellent heat insulation with an U-value of less than 0.5 W/m²K. A prismatic glass implemented in the space between the panes sun rays with an angle of incidence of more than 40° (in summer, when the sun is high in the sky). On the other hand, the winter sun passes through the sun protection at full intensity.
The central element of GLASSX®crystalis a heat storage module that receives and stores the solar energy and, after a time, releases it again as pleasant radiant heat. PCM (Phase Change Material) in the form of a salt hydrate is used as the storage material. The heat is stored by melting the PCM; the stored heat is released again when the PCM cools. The salt hydrate is hermetically sealed in polycarbonate containers that are painted grey to improve the absortion efficiency. On the interior side, the element is sealed by 6 mm tmepered safety glass that can be printed with any ceramic silk-screen print.



Summer sun high in the sky > 40°
Total reflecion of the rays



Shallow winter sun < 35°
Loss-free passage of the rays

The characteristics of GLASSX®crystal

Environment
Use of renewable solar energy. GLASSX®crystal produces clean solar heat for space heating by converting solar radiation into thermal energy.

Efficiency
GLASSX®crystal has high efficiency because line and storage losses do not apply. This system has no threshold losses; energy is input even in case of diffuse solar radiation.

Compact system
Low element thickness at a good U-value of less than 0.5 W/m²K. All the system components - transparent heat insulation, protection from overheating, energy conversion and thermal storage - are intergrated in one element.

Maintenance and service life
GLASSX®crystal contains neither mechanical components nor electronic controls, thus guaranteeing a long, serive-free useful lifetime as well as a high degree of dependability.

User friendlyness
GLASSX®crystal does not require technical know-how during operation, e.g. switching from summer to winter mode.

Fast and simple assembly
GLASSX®crystal can be installes by fassade construcors without specialized knowledge just normal insulating glass.

Comfort
High surface temperatures (26 °C to 28 °C) on the inside of the element lead to more room comfort. In winter, the inner side of GLASSX®crystal functions as a solar tiled stove, giving off uniform and pleasan radiant heat, which significantly improves the thermal comfort and thus the comfort in the home.

Form/ design
The freely selectable format of GLASSX®crystal permits it to be applied fleibly. The inner side, which can be printed individually, offers a large design latitude for architects and planners.

Versatile, innovative and completely maintenance free

Maintenance and lifetime

GlassX is a small flexible company - we put together a tailored solution for each contractor and architect – at no extra cost. With our façade systems we can offer sustainable solutions for a wide range of tasks and requirements.
The GlassX system components are perfectly matched to one another and can be optimally assembled for each building task.

GLASSX®crystal is a translucent wall element without any mechanical components or electronic devices. Thus the functionality may be guaranteed over a long lifetime without maintenance.

GLASSX
Storage Heating Cooling

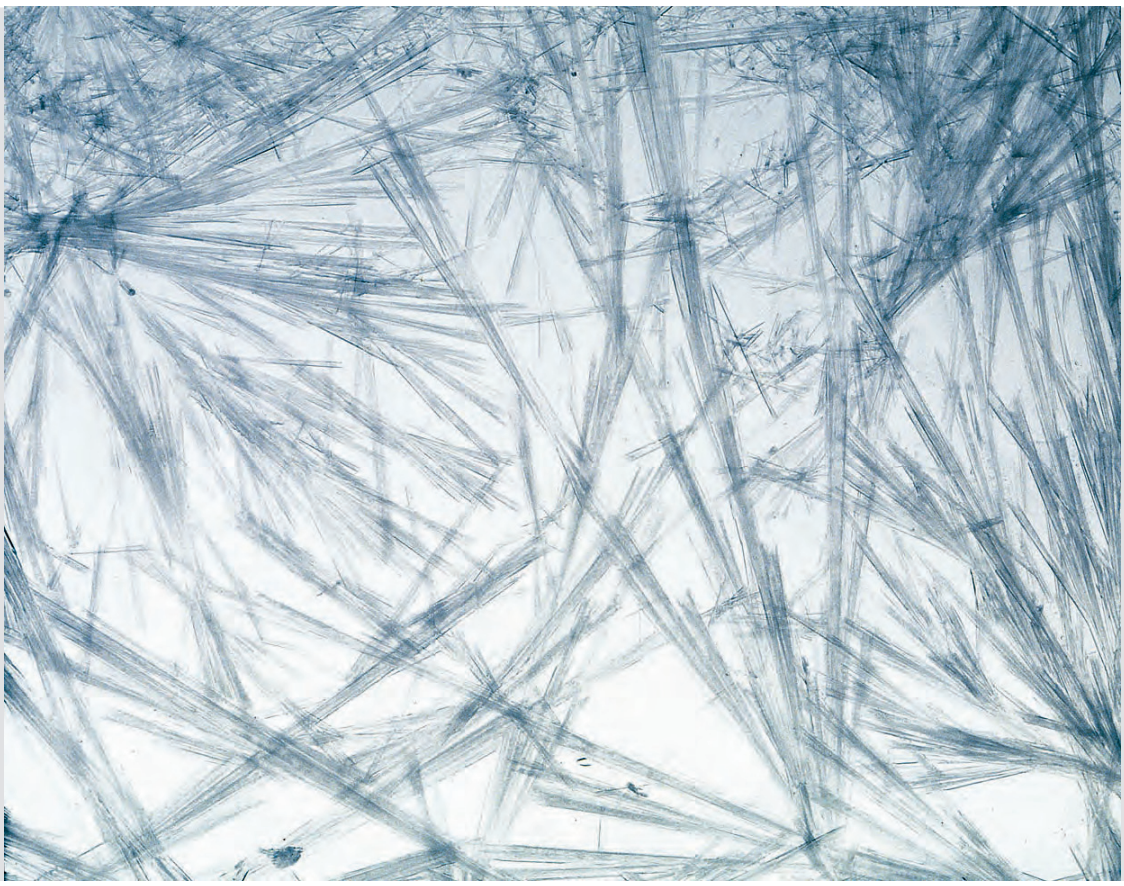
Intelligent, beautiful and always as its best

Self regulating

GlassX systems guide carefully metered daylight into the interior of the building independently of the season.
With Overheating protection by means of integrated light deflection, no external solar protection required.

In winter solar thermal gains are optimally attained, stored and released over a long period of time (10 times the thermal storage capacity of concrete).
GlassX PCM- panels increase the thermal mass with a minimum requirement in space and weight (thermal mass corresponds to a 20 cm thick concrete wall with 500kg/m2).

GLASSX
Storage Heating Cooling



Favorable, sustainable and always disposed for storage

Comfort in winter

Average surface temperatures of 27°C at the interior surface of the panel enhance thermal comfort in the room. The facade functions as a large area heat radiator producing a steady and comfortable climate.

Reducing thermal loads

A dual form of overheating protection is integrated:
a) Integrated overheating protection by means of seasonal light deflection (prismatic plate or alternatively adjustable blinds).

b) The PCM stabilises the room temperature at the point where it should be (< 26°C). In summer the PCM buffers thermal load peaks and thus significantly reduces the cooling loads.

Design freedom

The various size options of GLASSX®crystal enables a flexible use.
The individual designed interior surface allows to fit the element in different scenes.

GLASSX
Storage Heating Cooling

Efficient, unfailing and noticeable comfortable

Stimulating and healthy room atmosphere as a result of the high level of utilisation of daylight and passive interior climatisation.

The use of GlassX - panels leads to an energy rating reduction of 20% to 40%.
They feature a high and constant degree of efficiency for solar thermal gain (34%-40%).

GlassX - panels enable an efficient and comfortable utilization of light and heat without any follow - on costs.

GLASSX
Storage Heating Cooling

GLASSX SOLUTION TO EMERGING ENVELOP STANDARDS & GREENBUILDING INTIATIVES

Revolutionary Envelope Design

Problem / Need:

Traditional building heating and cooling systems are chronically overburdened due to solar gains of the building envelope and heat loss. Building insulation, cooling, heating, and seasonal fluctuations can make consistent thermal management exceptionally difficult. In fact, building consumption accounts for approximately 30 to 40% of all energy consumption in North America. The largest component of this energy consumption is from overuse of building heating and cooling systems, due to heat loss and solar gains of building envelopes.

Solution / Offer:

The GlassX system consistently delivers the right amount of thermal storage at the right time. Appearing as a translucent wall, GlassX uses a melting and re-crystallization material process in which solar heat is stored throughout the day and time-released at night. GlassX provides consistent thermal control, without the need for mechanical or electrical components.

The GlassX system is based around a slim heat storage module composed of a salt-hydrate PCM (Phase Change Material) with a thermal storage capacity of 376 BTU / ft^2, that is encased in a protective polycarbonate box. GlassX also includes a reflective prism module that deflects high-angle sunlight in summer, yet allows favourable solar gains in winter. With a thermal insulation U-value of 0.07 BTU / ft^2 (R12), GlassX surpasses traditional seasonal requirements for reducing winter heat loss and for retaining cool air inside during summer.

With an interior toughened glass pane and optional screen printings, pattern decor glass or frosted acid etching, GlassX also provides exciting aesthetics, natural day lighting, and environmental design possibilities, without sacrificing the glass-to-opaque-wall ratio, even on south facing facades.

GlassX is a thin but robust glass wall module that in combination with vision triple glazing not only meets but also surpasses all currently known energy design standards.

Emerging Standards Compliant

Problem / Need:

New ASHRAE 90.1 requirements for building envelopes restrict the vision-glazing area (with a U-value of 0.40) to less than 40% of the envelope. The remaining 60% would be required to meet greater than R12 opaque wall constructions. This new regulatory environment severely constrains the traditional range of possible wall-to-window ratios.

Solution / Offer:

By using GlassX, in combination with Vision Glazing areas, designs can surpass the new ASHRAE 90.1 requirements while creating the opportunity for use of a 100% glazing area in the design of the building, without sacrificing natural daylight components in building design.

Beyond ASHRAE Envelope Design (Net-Zero and LEED)

Problem / Need:

Evolving regulations for envelope design beyond ASHRAE include Net-Zero and LEED standards for building design, which present a set of challenging energy constraints that threaten trusted approaches to envelope design and glass architecture. It is now more important than ever for designers to seriously consider effective thermal storage and energy conservation, especially as they relate to envelope design.

Net-Zero is a new Energy Efficiency and Renewable Energy initiative in the U.S. Department of Energy's Building Technologies Program. A zero-energy building, also known as a Zero-Net-Energy building, is defined as a building with zero net energy consumption and zero carbon emissions annually, producing as much energy as it uses over the course of a year. Zero-Net-Energy buildings are highly energy efficient, while the remaining low energy needs are typically met with on-site renewable energy.

The type of net-zero definition to pursue depends on the goals of the design team and building owner. Building owners and designers are concerned with lowering energy costs, meeting energy code requirements, and reducing the environmental impact of energy emissions, all while avoiding high up front capital costs.

Solution / Offer:

GlassX provides an entirely new approach to thermal insulation and heat gains that preserves trusted approaches to solar envelope design, without sacrificing the glass-to-opaque-wall ratio, seasonal thermal control, overheating protection, or natural daylight transmittance.

Solar envelopes designed with GlassX (including, adequate envelope insulation, 60% glass façade, 30% vision-glass façade, and 30% GlassX façade) can cut expenses on heating and cooling by between 30 to 50%, resulting in excellent cost payback timelines when compared to less energy conserving options.

GlassX provides thermal insulation with a U-value of 0.07 BTU / F° / ft^2 (R12) encased in a triple insulating glazing unit.

By using the PCM (Phase Change Material) to reduce and store solar gains, with a prismatic pane in the outer most air-gap to reflect high altitude summer solar radiation, and by transmitting it at altitudes below 35° in winter, GlassX meets and even surpasses all proposed criteria for solar gains and thermal control.