Copyright: SunCatcher Greenhouse, 2026.

VII - Greenhouse Glazing Materials

Glazing is a critical component of any greenhouse envelop, especially for passive solar greenhouses. Larger south-facing glazing areas provide more solar energy for heating the structure and light used for photosynthesis by the plants, especially during the winter period. The east and west sides of the PSG should include some glazing (windows, doors with some glass) to allow diffuse light into the greenhouse throughout the day (before and after the 9-3 solar time slot if possible). This will increase the time sunlight is available for photosynthesis.

The primary purposes of the passive solar greenhouse glazing include:

1. Maximizing the available sunlight entering the PSG in the winter months.
2. Keeping heat in during the winter.
3. Reflecting the high angle summer sunlight to reduce overheating during this period.

To meet these purposes, the ideal properties of greenhouse glazing materials include:

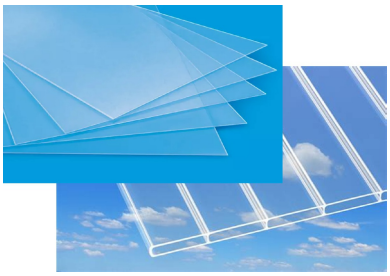
- Good light (energy) transmittance through the glazing.
- Low UV transmission, as UV light is not good for plants or humans.
- Opaque to long-wave infrared radiation to prevent heat from leaking out, in other words, keep the heat inside.
- Low thermal conductivity (high R-value) (= how well the glazing conducts heat through itself).
- Cost of the glazing, its installation, and labor required to maintain it.
- Durability (=life span before replacement).
- Adapted to the local climate, seasonal variations of light and temperature, and ability to withstand extreme weather events (wind, hail).

Although there are several glazing materials available, cost, weight, and/or ease of installation become major factors in considering the types of glazing for a greenhouse. The main types of glazing used today are Polyethylene sheeting and Polycarbonate panels, although glass greenhouses are still widely used in commercial operations (see photo below). Good glazing should be opaque to infrared (IR) so that heat doesn't escape easily at night. Some materials are naturally opaque (glass, acrylic), while others like polyethylene (PE) are transparent. Today's IR-coated greenhouse PE films help reduce this issue. Tables with basic characteristics of different glazing materials are provided at the end of this chapter.

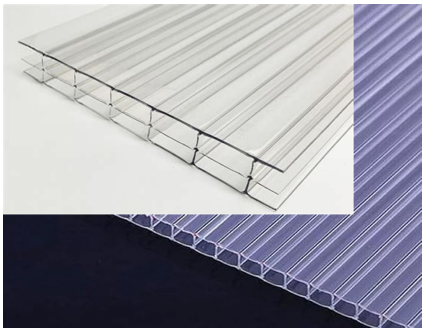


The most expensive glazing is glass, both its cost and the labor involved in installation. It has a long life span (25-30 years) and high light transmission and good

light diffusion. Given its weight, it requires a very strong frame adding extra costs. Its R-value depends on its thickness, the type of glass, whether single or double pane, or low-E (0.96 - 3.45). Glass is, of course, very breakable and subject to hail damage - think about picking out all the glass shards from your plants!!!



Acrylic panels (Plexiglass) have similar light transmission, diffusion, R-values and life span as glass, but are lighter in weight and resistant to hail damage and breakage. However, acrylic is not scratch resistant. It comes in single-wall (plexiglass of different thickness) and twin and triple-walled versions. Acrylic's life-span and cost are high - similar to double-pane glass.



Polycarbonate is a rigid transparent plastic with similar light transmission and diffusion as glass and acrylic. Light transmission decreases by the number of walls and thickness of the material, but increases its R-value. It is scratch resistant and withstands high winds and hail, unlike glass. Its costs per square foot is similar to glass, but [given its lighter weight] does not require a strong frame and is easier to install. Its life span is a few years shorter than glass.

For our SunCatcher greenhouses, we recommend 3-wall polycarbonate glazing (R-value = 2.5) as the most cost-effective option for a good balance between thermal insulating properties, light transmission and durability. It provides more insulation, light penetration, and strength than polyethylene.

The cheapest option is 6 mil Polyethylene (PE) greenhouse plastic sheeting which is UV-treated to slow its degradation in sunlight; even so, it usually needs to be replaced every 4-5 years. It can be purchased with additional features, such IR coating (to keep heat inside the greenhouse) and anti-condensation coatings or anti-dust additives to allow for better light transmission. It is susceptible to tears and rips, and less able to withstand strong winds and heavy snow loads. The heavier, 10 mil string-reinforced/woven PE sheeting is better able to withstand tears and harsh weather conditions and may last a bit longer. PE sheeting does not provide much insulation R= 0.83); two layers of polyethylene (separated by air blown between layers by a small fan) provide more insulation R= 1.25). It should only be used in warmer climates.



Hoophouses covered with single-layer polyethylene sheeting.

PE is also available in corrugated rolls (similar to corrugated cardboard). Depending on thickness (it is available in 3.5 and 5mm), corrugated PE has a higher R-value than PE sheeting (2.1-2.3) . Corrugated PE is translucent (kind of milky white in color), NOT transparent as shown in the photos below. Corrugated PE was used on the A-frame experimental greenhouse (see Chapter IV), but we found it did not have good thermal performance and light transmission (Against the Grain farm uses additional LED grow lights to produce better quality seedlings).







Corrugated PE covered greenhouse at Against the Grain farm, Zionville, NC. Top-right of greenhouse is a solar hot water collector. Photos: den Biggelaar, Nov 29, 2025.

An overview of light transmission of different wavelengths and heat loss coefficients (U values) of greenhouse glazing materials are provided on the following two pages.

Once the glazing is installed on a PSG, light colored (silver, white, beige, etc.) shade clothes can be used on the exterior or interior of the main south-facing glazing (but not the south-wall vents) to reduce the amount of sunlight entering the structure (especially in spring and fall).

Further Readings

Sections in the following books provide excellent discussions of glazing options:

Schiller & Plinke, 2016. Controlling light and heat gain: Glazing, pp. 41-67.

Yanda & Fisher, 1981. A comparison of glazing materials, pp 68-69.

Light transmittance and U-values of different greenhouse glazing materials as well as some construction materials

Table 1. Comparison of characteristics for greenhouse glazing materials.

Cladding material	Transmittance (%)			Life expectancy (years)
	PAR[z]	Infrared[y]	Ultraviolet[x]	
Glass	90	< 3	60-70	30+
Acrylic[y]	86	< 3	44	20
Polycarbonate[w]	75	< 3	18	10
Polyethylene[v]	88	50	80	3-4
PE, IR & AC[uv]	88	30	80	3-4

[z]Photosynthetically Active Radiation (400 to 700 nm); Energy source for the process of photosynthesis
[y]Infrared heat transmittance (>3,000 nm)
[x]Wavelengths (300 to 400 nm)
[w]Twin wall
[v]Single layer
[u]Polyethylene film with an infrared barrier and an anti-condensate surface treatment

Table 2. Heat-loss coefficients (U-values) for glazing and construction materials.

Cladding material	U (Btu/hour per sq. ft. per °F) = 1/R
Single (double) layer glass	1.1 (0.7)
Single (double) layer polyethylene	1.1 (0.7)
Double layer + energy curtain	0.3-0.5
Twin-wall layer acrylic	0.6
Twin-wall polycarbonate	0.6
1/2-inch plywood	0.7
8-inch concrete block	0.5
2-inch polystyrene board	0.1

Source: A.J. Both. ND. Greenhouse glazing. https://www.canr.msu.edu/floriculture/uploads/files/AJBothGreenhouseGlazing.pdf , accessed Nov 10, 2025.

Light transmission of PAR and different light colors of greenhouse glazing materials.

Material	PAR / PPFD [1]		Red		Green		Blue		LUX	
	µmol/m²·s	%	µmol/m²·s	%	µmol/m²·s	%	µmol/m²·s	%	LUX	%
No covering	1521	100	642	100	555	100	324	100	291010	100
4mm glass	1322	87	551	86	489	88	282	87	258089	89
6mil polyfilm single-layer	1238	81	532	83	448	81	258	80	255088	88
8mm polycarbonate (Riga)	1216	80	518	81	443	80	255	79	234080	80
4mm polycarbonate	1192	78.4	509	79.3	433	78	221	68.2	209072	72
6mil polyfilm double-layer	1130	74	492	77	408	74	231	71	225077	77
8mm polycarbonate (RSI)	1043	69	443	69	379	68	221	68	209072	72
10mm polycarbonate (Riga)	932	61	402	63	336	61	194	60	220076	76
16mm triple wall polycarbonate	977	64	423	66	351	63	203	63	217075	75
3.5mm Solexx	757	50	344	54	269	48	143	44	165057	57
8mm light-diffusing polycarbonate (RSI)	711	47	307	48	254	46	149	46	168058	58
5mm Solexx	666	44	304	47	237	43	125	39	153053	53
8mm tinted polycarbonate (RSI)	602	40	286	45	208	37	108	33	117040	40

[1] PPFD=Photosynthetic Photon Flux density

Photosynthetic Photon Flux Density (PPFD) measures the amount of light available for photosynthesis. It quantifies the number of photons in the 400-700 nanometer range that reach a specific area per second. The unit of measurement is micromoles per square meter per second (µmol/m²/s).

Source:
https://greenhouseemporium.com/greenhouse-glazing-materials-best-for-light-transmission/#elementor-toc__heading-anchor-4, accessed February 24, 2026.