ASI® Glass

Integrated Architecture
Powered by the Sun

SCHOTT solar

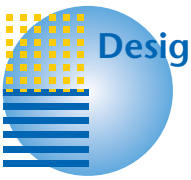
BIPV – Building Integrated Photovoltaics with ASI® Glass

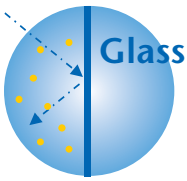
All the benefits of glass plus integrated solar power

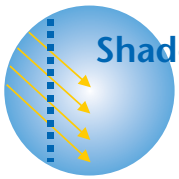
Whether a facade or a roof, today's building envelope fulfills multiple purposes.
Along with its conventional roles of providing privacy and protection from rain and noise, additional factors are becoming increasingly important, such as thermal insulation and shading. All of these requirements are addressed by the shell of the building.

Today, building integrated photovoltaic systems are able to provide all of these functions plus solar electricity.

- Solar electricity generation
- Light management
- Comfort
- Effective shading
- Glare protection
- Thermal management
- Innovative architecture
- Cost savings by combining and integrating several functions


Design


Glass


Shade


C°
Thermal
Insulation

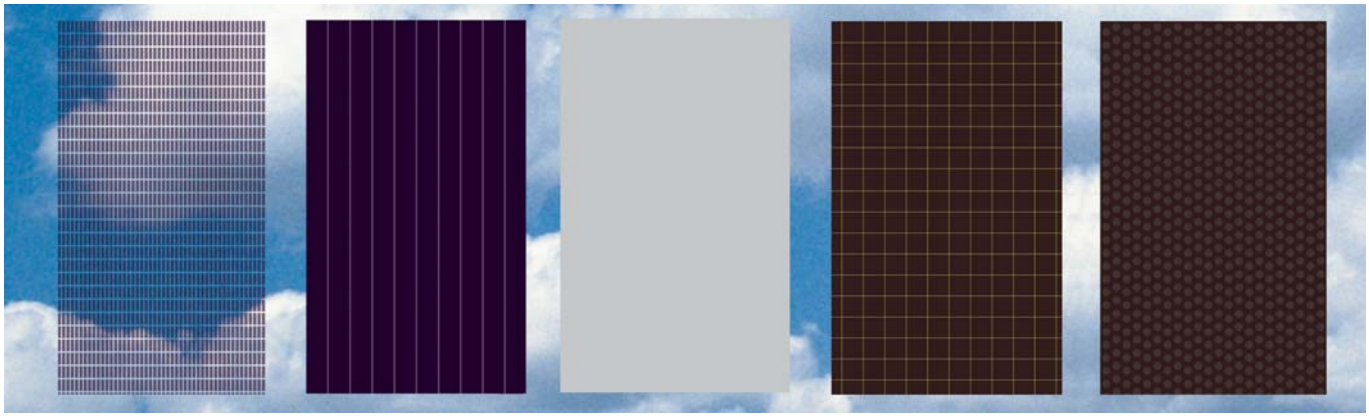

Solar
Electricity

Design options with ASI® Glass

Integrated solar modules from transparent to opaque

ASI® Glass elements are available in various design options. Depending on the application and the desired architectural appearance, this flexibility always allows the designer to optimize the integration of solar panels into the building.

ASI OPAK®



ASI THRU® *ASI OPAK®* *ASI OPAK® White* *ASI OPAK® CreativeLine* *ASI OPAK® EleganceLine*

ASI THRU® facade

ASI THRU® is a semi-transparent module with a see-through effect. It is available in laminated form or as double glazed units.
ASI OPAK® is the technology for homogeneous facade surfaces, where no vision is required.
ASI OPAK® White offers a completely uniform appearance.
ASI OPAK® CreativeLine and **EleganceLine** offer unique surface patterns, allowing new architectural design possibilities. Customer-specific patterns can also be produced.

The following designs and module constructions are available as customer specific solutions:
ASI FADE® provides a gradual fade to clear glass
ASI SHADE® integrates shading louvers with double glazed units to provide the ultimate in glare protection

Anti-reflective coating

All of the above options – laminated or double glazed – are also available with AMIRAN® antireflective glass from the SCHOTT group. This significantly reduces the average light reflectivity, enhances the performance of the solar power and eliminates obtrusive reflections.

ASI OPAK® EleganceLine facade

ASI OPAK® White facade

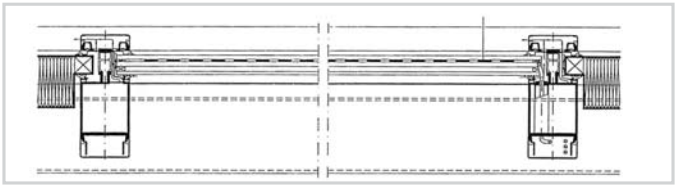
Engineering with ASI® Glass

Effective with conventional glazing systems

There are special solar cell encapsulations available for every application, for example, laminated glass for overhead applications. Used horizontally or vertically, ASI® Glass solar modules fulfill the requirements of the construction industry and can be used with almost all conventional framing systems. Static load requirements can be met by changing the type and thickness of the glass panes. The encapsulation of ASI® solar cells in laminated or double glazed constructions makes use of proven technology and manufacturing methods.

In addition to a large number of standard types and sizes, customized solutions can also be provided. Please contact us for additional information.

The maximum size of ASI® Glass modules is 1.2 m x 2.4 m (~4′ x 7′10″)



Cables are within the framing system

Canopy

Insulated roof glazing

Louvers

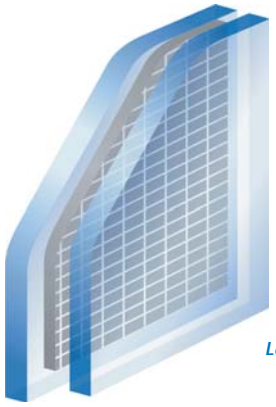
Opaque cladding

Insulated facade

Integrated roof panels

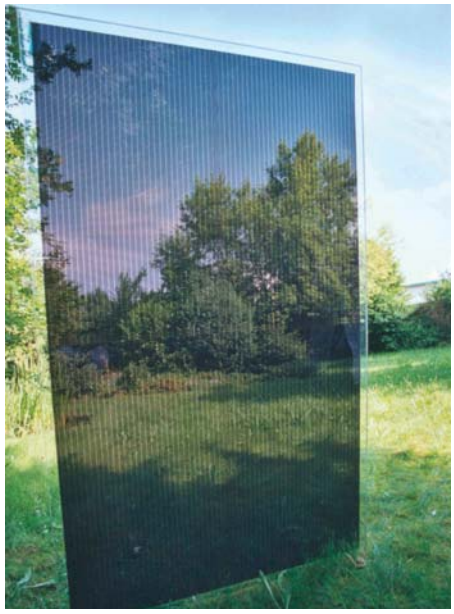
Module options with ASI® Glass

Double glazing



Laminate

Glass laminates and double glazed units incorporating ASI® solar panels are compatible with commercially available metal profile systems.



The maximum size of ASI® Glass modules is 1.2 m x 2.4 m (~4′ x 7′10″)

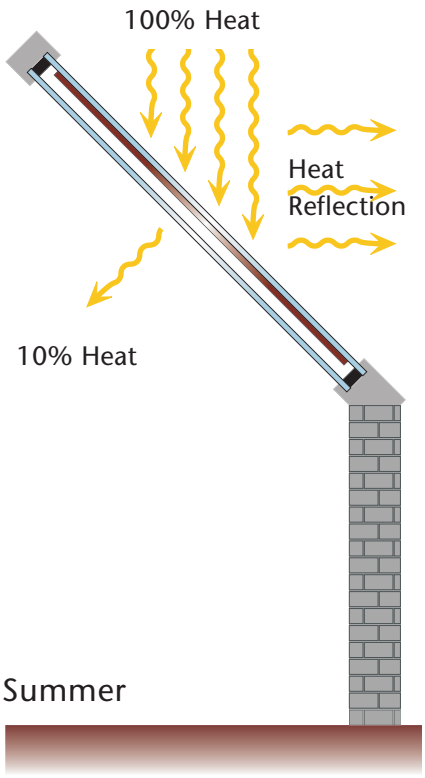
Shade

Solar control and shading with ASI® Glass

Minimizing heat gain in summer

In order to reduce the influx of thermal energy during the summer months, the glazing must be provided with some sort of sun shielding. This may be accomplished by additional coatings on the glass, the roller blinds or venetian blinds. The energy transmission of the entire solar spectrum is determined by the g-value – the smaller the g-value, the more effective the shielding.

In the table below various sun shielding techniques are compared with ASI THRU® in double glazing elements.

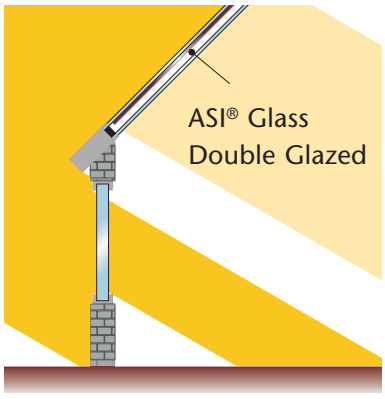


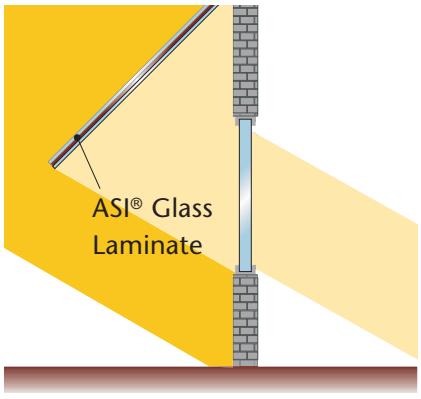
Solar Heat Gain Coefficient (SHGC) comparison of different glazing and shading systems with ASI THRU® double glazed units

	SHGC (g-value)
GLAZING	
Single glass pane	~80%
Double glazed with uncoated glass	~80%
Double glazed with solar control coating	30 - 70%
ASI THRU® double glazed unit	**10%**
SHADING SYSTEMS	
External Venetian blind (white)*	12%
External fabric canopy*	9%
Internal roller blind (white)*	40%

** at values in combination with double glazed windows with a SHGC = 61% and a U-value of 1.4 W/m²K (0.24 Btu/hr ft²F)*

Typical Applications



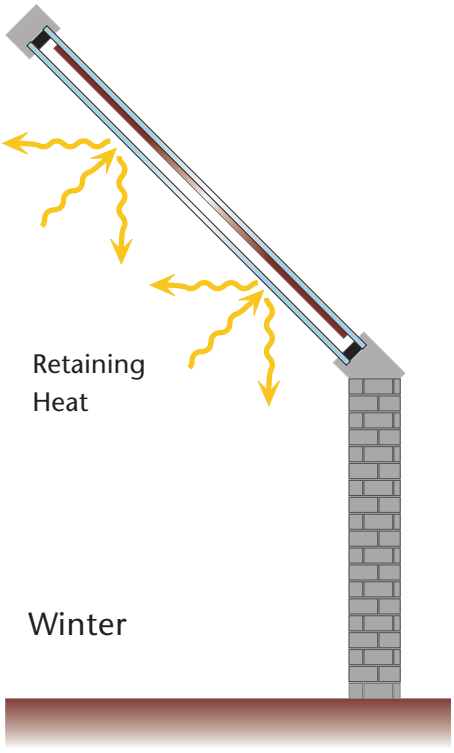


Thermal Insulation

Building insulation with ASI® Glass

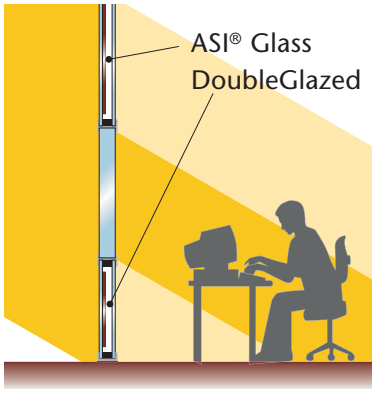
Minimizing thermal loss in winter

The U-value refers to the thermal insulation effect of the building; it is the coefficient of heat transmission for the materials that comprise the building shell. The glazing must serve two purposes: it must be transparent to sunlight, but insulate from thermal radiation. Modern glass coatings (low-e coatings) facilitate the separation of the shorter wavelength sunlight from the longer wavelength thermal radiation. In the table below U-values of various glazing systems are compared to those of ASI THRU® double glazing. The photovoltaic ASI THRU® double glazed elements reach low U-values comparable with high-quality conventional double glazing; hence they are suitable for large areas of glazing without sacrificing any loss in thermal comfort during the winter and, most importantly, with the additional benefit of generating electricity.



Comparison of the heat transmittance values of ASI THRU® double glazed units to other glazing configurations

	U-Value (EN673)	US Standard
Single glass pane or laminated glass	5-6 W/m² K	0.88-1.1 Btu/hr ft² F
Double glazed unit without low-e coating	2.7 W/m² K	0.48 Btu/hr ft² F
Double glazed unit with low-e coating	1.2 W/m² K	0.21 Btu/hr ft2 F
ASI THRU® double glazed unit	**1.2 W/m² K**	**0.21 Btu/hr ft² F**



Solar Electricity

The ASI® solar cell technology

Optimized for building integration

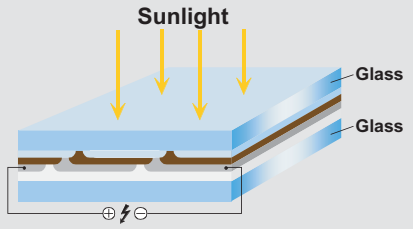
The ASI® semiconductor converts sunlight directly into electrical power. It is applied in very thin layers (<1 µm) on glass, so only one gram of semiconductor material is needed per square meter (~11 square feet) of modular surface. The semiconductor material consists of 99% silicon, derived from quartz sand. The ASI® semiconductor is free of heavy metals such as cadmium.

Why ASI® modules for building integration?
In addition to their homogeneous surfaces, thin film solar modules based on amorphous silicon have decisive advantages for building integration compared with crystalline solar cells.

- Reliable power output even at low light levels down to 10% of full sun - a typical light condition on overcast days or caused by shading from neighboring buildings.
- The very small temperature coefficient of the power output guarantees almost full power at higher cell temperatures, as typically encountered with building integration.

The performance at low light levels or high cell temperatures leads to significantly higher energy yields during the course of a year. This has been proven by independent studies (copies of these studies are available on request).

ASI® Thin Film Solar Cell - How it works



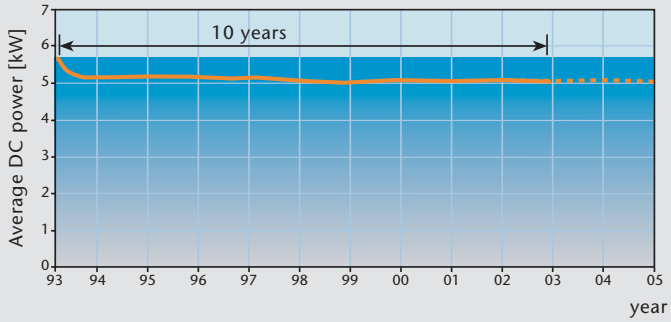
The ASI® Solar Cell is made of amorphous silicon. The sunlight frees electrons in the semiconductor layer. Each strip is one solar cell. The cells are connected by laser line bridges.

Up to 20% more energy per rated Watt Peak (Wp) compared with crystalline solar cells

Bavarian Ministry of Environment

In 1993 the Bavarian Ministry of Environment installed one of the first ASI OPAK® facades. Ten years later, in 2003 the building was fully renovated. The ASI OPAK® facade is still in place. Measurements of the solar facade, conducted by an independent research institute, show the long term stability offered by ASI® technology. The graph shows the average DC power output over the course of the last 10 years.

ASI® solar modules – stable energy yield and long lifetime



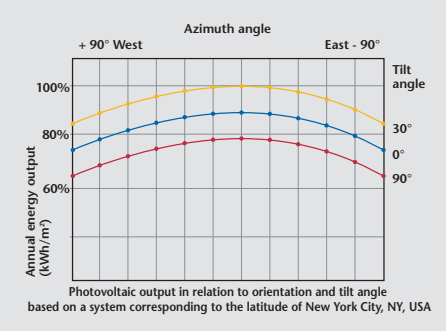
Average DC power measurements at the solar facade of the Bavarian Ministry of Environment

Solar Electricity

Solar electricity

Electrical energy

The nominal electrical power of solar modules is rated according to Standard Test Conditions. This value is usually given in Watt peak (W_p). The energy yield during the course of a year depends on the location and orientation (azimuth angle and tilt angle) of the photovoltaic elements. The graph shows the principal energy yield depending on the azimuth angle and tilt angle of the module based on a system in New York City, NY (USA). The actual energy yield may depend upon the local situation, such as shading influences of neighboring buildings.



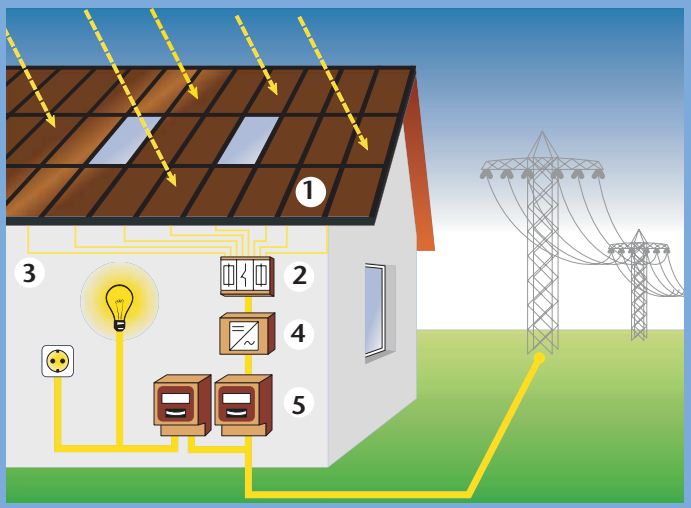
Photovoltaic output in relation to orientation and tilt angle based on a system corresponding to the latitude of New York City, NY, USA

Stabilized nominal power according to Standard Test Conditions (STC)

ASI THRU®	ASI OPAK®
42 Wp/m²	53 Wp/m²
3.9 Wp/ft²	4.9 Wp/ft²

Solar modules generate DC-power that is converted by the inverter to AC. The inverter connects the photovoltaic system to the grid, the most effective and economical way of using solar electricity for a building. Usually most of the solar power is consumed by lighting and plug loads in the building. Excess power is fed into the grid for credit. If the energy power supplier offers a buy back plan, all power all power generated may be fed into the grid.

A grid-connected PV system is usually built with the following components:
1: Solar modules
2: Combiner box
3: Cabling
4: Inverter
5: Meter



All pictures on this page: Primary school Markgrafenstraße Munich, Architect: Prof. Krug and Partners. By courtesy of building authority of Munich

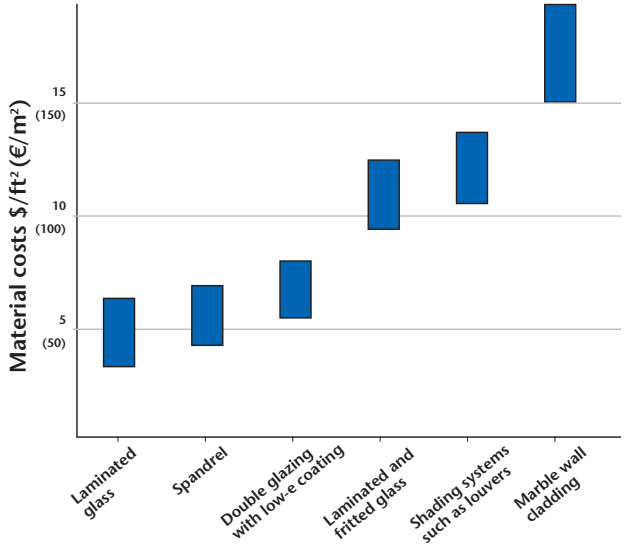
Cost Savings with ASI® Glass

Comparison with conventional glazing systems

Besides generating electricity, ASI® Glass elements fulfill different functions such as the glazing or shading of a building envelope. The costs for these construction materials are eliminated when ASI® Glass elements are used. Subtracting the savings on the conventional construction material from the overall costs for the ASI® Glass photovoltaic system, results in the actual costs for the photovoltaic system.

Conventional Facade		**ASI® Glass Facade**	**Cost difference between ASI® Glass and a conventional installation**
Shading system if needed	Replace	Electrical installation	
Conventional glazing or cladding material		ASI® Glass elements	
Construction work			
Sub construction: cladding, framing system etc.			Additional costs for PV system
			Energy yield

Average costs for different construction materials



The figure shows budget prices for conventional glazing or cladding materials and shading systems. These materials could be replaced by the ASI® Glass elements.

All pictures on this page: GVZ Ingolstadt, pbb Architects + Engineers. By courtesy of IFG Ingolstadt

About SCHOTT Solar

SCHOTT is an international technology group that sees its core purpose as the lasting improvement of living and working conditions. For this purpose special materials, components and systems are developed. The main areas of focus are the household appliances industry, optics and opto-electronics, pharmaceuticals and solar energy. The SCHOTT Group has approximately 17,000 employees producing worldwide sales of 2 billion euros.

SCHOTT Solar GmbH is a world leading company covering various segments of solar power products: fully integrated production of silicon wafers, solar cells and modules for the terrestrial market and thin-film modules based on amorphous silicon (ASI®). The ASI® Glass products are engineered and produced especially for building integration. Sales offices offer their services in all major markets and ensure an efficient and reliable realization of your projects.

All pictures on this page: Stillwell Avenue Terminal, New York. By courtesy of MTA New York

Please contact the local SCHOTT Office at the following address

Inspiration - Powered by the sun

We would be pleased to advise on how you can use ASI® Glass products in your projects. Please contact us or your local ASI® Glass representative.

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