

A large, multi-story atrium with a glass skylight and a black sign reading 'onyx SOLAR'. The atrium features multiple levels with glass railings and a central white pillar. The skylight is composed of a grid of glass panels, some of which are illuminated from within, creating a bright, modern atmosphere. The sign is mounted on a tall, thin white pole.

onyx  
SOLAR

**LOW-E  
PHOTOVOLTAIC  
GLASS  
TECHNICAL GUIDE**





# PHOTOVOLTAIC LOW-E GLASS

“ Glass with lower solar heat gain coefficient uses for vision glass would results in reducing cooling loads

Perking & Will Research Journal, Chicago, Illinois Vol 02.02.

Choosing a suitable glazing for the particular needs of a building is not always an easy task, bearing in mind all the variables that must be considered when talking about energy efficient designs and the great variety of glass build ups. In this sense, failing to select a suitable glass can lead to building’s inner incommmodity which would negatively affect especially<sup>1</sup>, officespaces. In order to choose an optimal glazing, both optic

and thermal characteristics must be observed under a straight interrelation with the local climate. At Onyx Solar we know that the cheapest energy is the energy that is not consumed, which is why we offer multi-function construction solutions which can be integrated perfectly into any type of building, provide greater insulation and at the same time produce clean, free energy in situ, all thanks to the power of the sun.

## SELECTIVE INFRARED RADIATION FILTER

Infrared radiation, coming from natural light, causes heat’s buildup inside buildings; this situation leads to thermal unbalances during summer time and increases the need for HVAC systems<sup>2</sup>.

Measurements carried out on Onyx Solar™ ThinFilm photovoltaic glazing show a significant decrease in radiation transmission among the 780nm-2500nm range (near infrared, N-IR). Particularly the Onyx Solar™

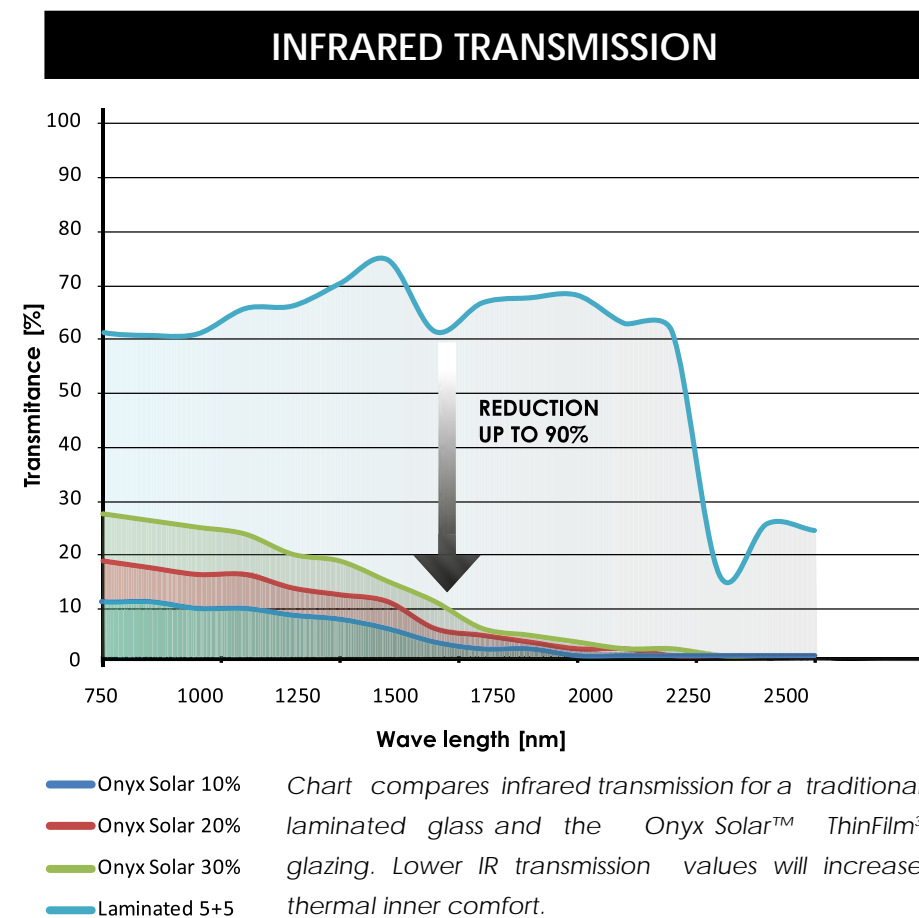
Thin Film photovoltaic glazing decreases infrared transmission up to 90% compared to a traditional laminated glass. This behavior, which states the radiation filter within the undesired spectrum range, is similar to the one observed on low-emissivity glazings, where such absorption is also observed.

Particularly, the double laminated Onyx Solar™

ThinFilm glazing filters between 85 to 95% out of the total infrared radiation, while a a double laminated Low-E glazing filters between 80 to 85%<sup>4</sup> only.

“ Thoughtful workplace design can be a powerful tool for supporting employee performance. And a collateral benefit is that what typically supports productivity also enhances employee health and wellness.

HOK



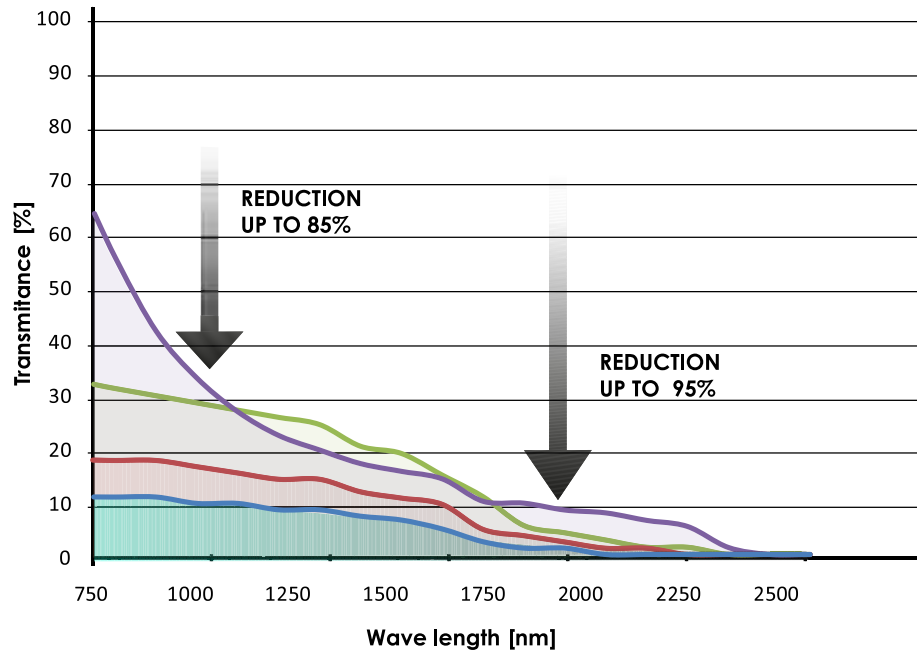
<sup>1</sup> C. Huizenga, et al. Results of a Large Indoor Environmental Quality Survey. Center for the Built Environment, University of California.

<sup>2</sup> Natural light usage for the illumination of buildings. Ministry of Industry, Tourism and Commerce 2005.

<sup>3</sup> Measures carried out with an spectrophotometer Spectrometer Lambda 900 UV/VIS/NIR from Perkin-Elmer, counting on a integrating sphere of 150mm diameter.

<sup>4</sup> Notice that in the previous case it was analyzed the decrease compared to a conventional glazing, while this case compares the decrease regarding the total incident radiation.

## INFRARED RADIATION TRANSMISSION



— Onyx Solar 10%  
 — Onyx Solar 20%  
 — Onyx Solar 30%  
 — Laminated Low-E 6+6

Chart above shows the infrared radiation transmission for a conventional laminated Low-Emissive glass and the laminated Onyx Solar™ ThinFilm glass. A similar output is reached by both type of glazings.

*Thermal Comfort and temperature are one of the fundamental design elements that can positively impact the workplace environment and support the work being done*

HOK

# OPTIMIZED SOLAR FACTOR

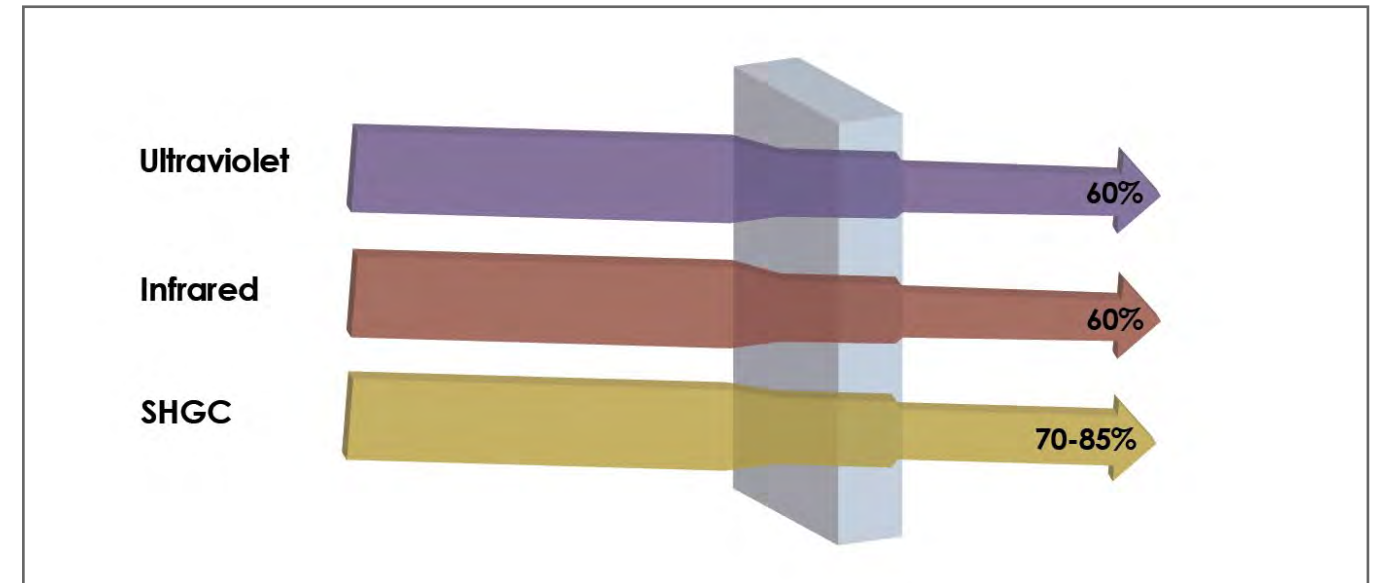
This change of the optical properties relates to the solar factor, known as g-value or SHGC (Solar Heat Gain Coefficient). This coefficient indicates the quantity of energy that a glazing allows to go through and enter the interior of the building, out of the total incident solar radiation.

This factor is critical in order to reach thermal inner comfort within the building. In this sense, a high g-value can lead to high temperatures

effect, while a low g-value will avoid it to happen (especially if we are talking about warm climates). In this sense, the Onyx Solar™ ThinFilm glazings show a g-value ranging from 10 to 40%, which makes them an ideal candidate to control inner thermal conditions.

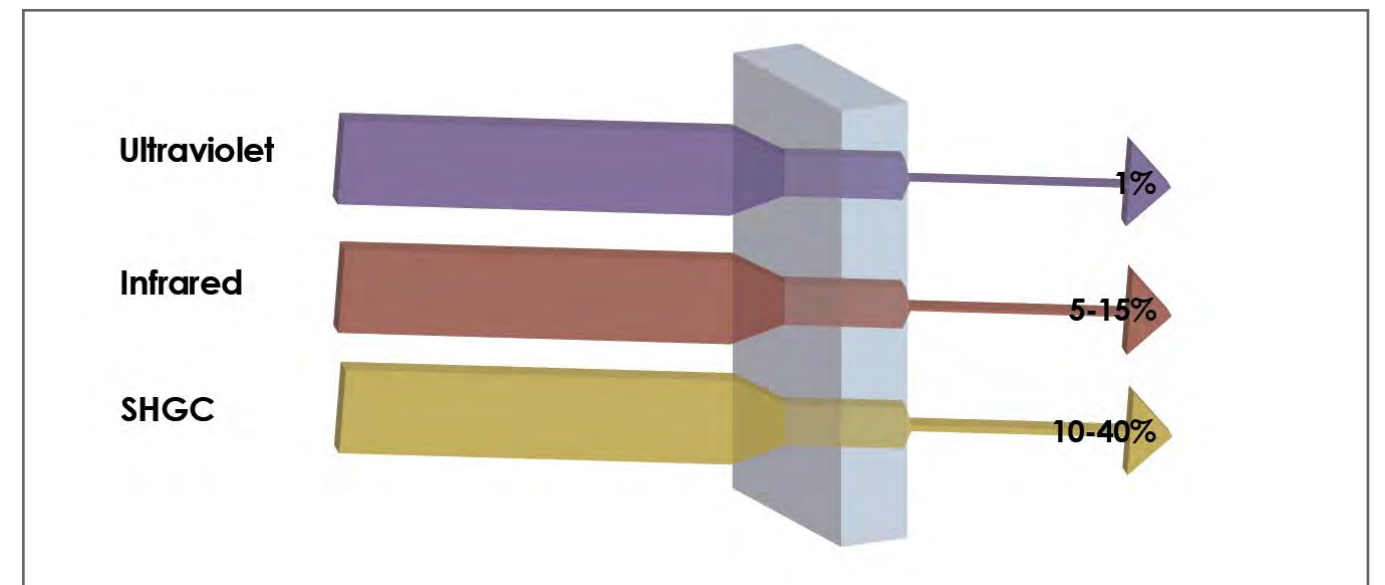


## OPTICAL PROPERTIES OF CONVENTIONAL GLASS



Conventional Glass: main optical properties for a conventional glass. Harmful radiation and solar heat gain coefficient.

## OPTICAL PROPERTIES OF ONYX THINFILM



Onyx ThinFilm: main optical properties for Onyx Solar ThinFilm glass. Harmful radiation and solar heat gain coefficient.





## SELECTIVE UV FILTER

Another key factor to consider when choosing the right glazing is the negative impact of ultraviolet (UV) radiation over the interiors, furnishings and people. **In this way, the architectonic photovoltaic glazings developed by Onyx Solar™ filter up to 99% of the ultraviolet radiation.**

*"To see the damage that untreated glass can do, take a close look at the furnishings in your home that are hit by direct sunlight," says Perry Robins, MD, President of The Skin Cancer Foundation. "If the sun has faded the color of your sofa, it can just as easily damage your skin when you sit there."*

*"While it's understood that taking sun safety precautions is important outside, few people realize they can sustain sun damage indoors, too. Both ultraviolet A (UVA) and ultraviolet B (UVB) radiation from the sun can harm the skin and lead to skin cancers". Perry Robins, MD, President of The Skin Cancer Foundation*

## NATURAL ILLUMINATION

It is important to highlight that the photovoltaic glazings show different see-thru degree allowing natural illumination inside the building.

This is achieved thanks to a laser etching process that removes precise lines of active Silicon film over the surface of the glass.

In this way, the natural light that passes through Onyx Solar™ ThinFilm glass shows a greater diffuse component enhancing building end user's comfort.

Depending on the silicon film area removed with the laser, light transmission can vary from 10 to 30% which is normally the perfect range for an optimal light condition.

The pattern achieved by the Onyx Solar photovoltaic glass is a perfect alternate to any frit pattern additionally applied over a conventional glass for a better performance.



## REFLECTION

Regarding the light reflection produced by the photovoltaic glass, values go from 7 to 9%. These values are similar to conventional glazing which normally ranges from 6 to 10%.





# THERMAL INSULATION

Talking about thermal performance, it is expressed by the thermal transmittance of the glazing, known as the U-value. This parameter denotes the quantity of heat that goes through the glazing when its two surfaces show different temperatures (thermal gradient).

The lower the U-value is, the best thermal performance the glass will reach and therefore the more energy efficient the building will be leading to significant building O&M cost savings.

In addition, The **Onyx Solar™ Low-E photovoltaic glass** can also be built as **Insulating Glass Unit (IGU)** offering U-values as low as **0.73 W/m<sup>2</sup>K (0,13 BTU/hft<sup>2</sup>F°)**, which equals the most performing Low-E glazings of the market.

## U VALUE

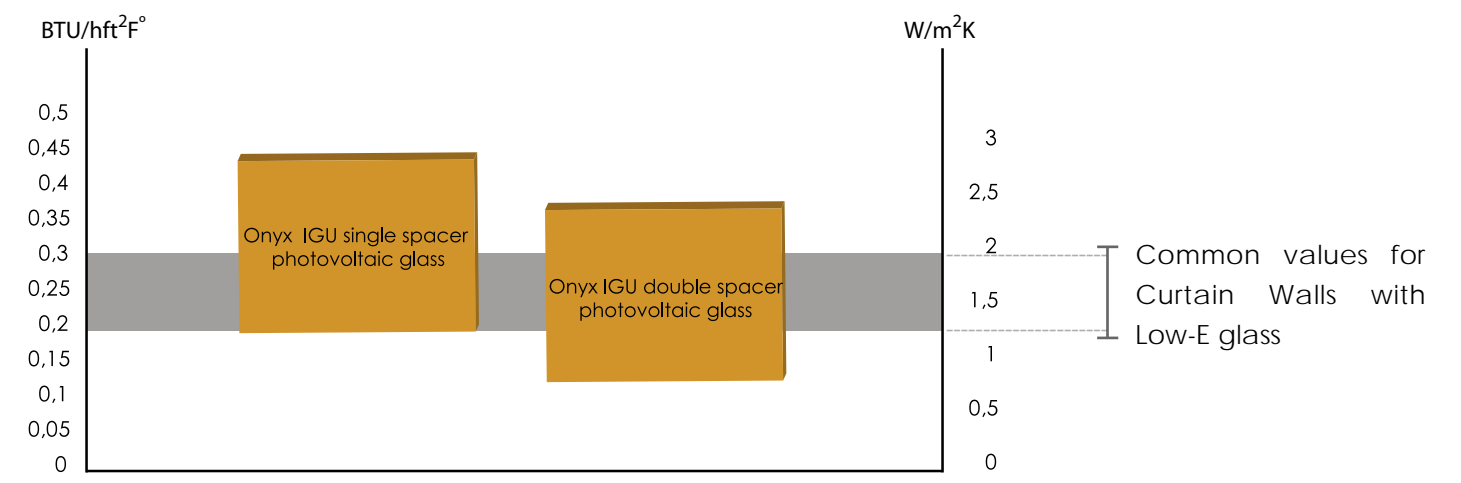
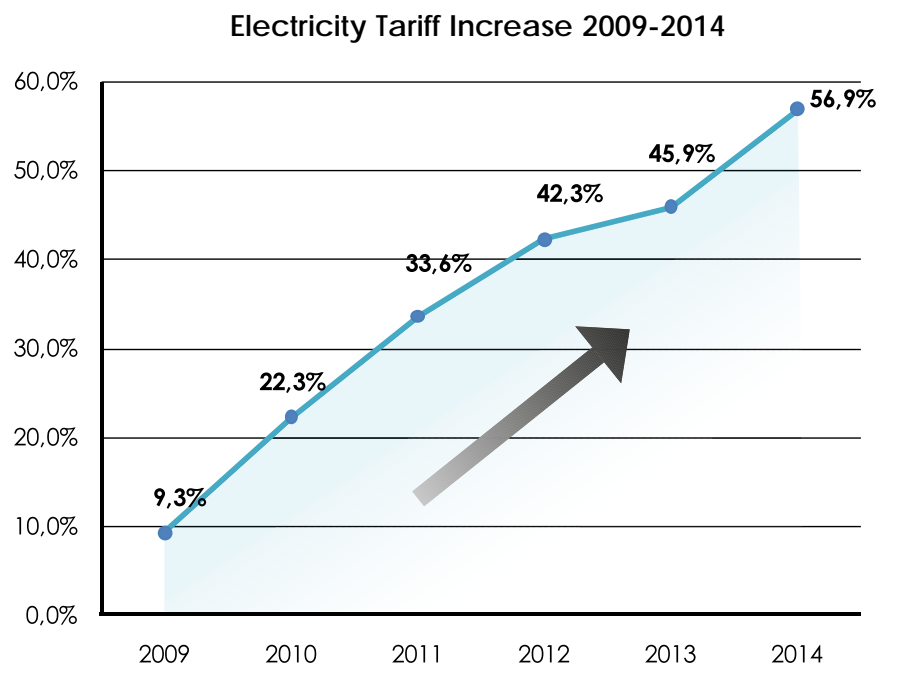


Chart shows the U-value for several type of glazing. The lower the U-value is, the more energy efficient the building will be. (1 W/m<sup>2</sup>K=0,1761 BTU/hft<sup>2</sup>F°)

# CLEAN ENERGY GENERATION

Apart from the great performance of the photovoltaic glazing developed by Onyx Solar, it must be highlighted that it is a glazing that produces electricity when the Sun hits it. This is due to the precise active layers of photovoltaic material which is CVD-deposited over one of the glass surfaces. As an example, 100 SQM of photovoltaic glass in a city like Los Angeles could feed up to 250 light points during working hours for 25 years or more.



It is free and clean electricity from the Sun which saves costs to the consumer, who normally faces electricity price increases.

The photovoltaic glass developed by Onyx Solar™ is a perfect, multifunctional alternative equal to a conventional Low-E glass which is pretty common in the buildings construction field.

Onyx Solar glazing is designed leading to optimized optical and thermal properties where free and clean electricity from the Sun becomes a plus.





The pictures shown above belong to San Anton Market located in Madrid. This skylight is composed by photovoltaic glass with 20% of transparency degree.

Our glass is available in dark, 10%, 20% and 30% semi-transparency degree (see pictures).

LIGHT TRANSMISSION	OUTSIDE OF THE BUILDING	INSIDE OF THE BUILDING	PEAK POWER
DARK-0%			<b>62 Wp/m<sup>2</sup></b> 5.754 W/ft <sup>2</sup>
S CLEAR-10%			<b>44 Wp/m<sup>2</sup></b> 4.087 W/ft <sup>2</sup>
M CLEAR-20%			<b>38 Wp/m<sup>2</sup></b> 3.530 W/ft <sup>2</sup>
L CLEAR-30%			<b>32 Wp/m<sup>2</sup></b> 2.972 W/ft <sup>2</sup>

	ONYX SOLAR™	LOW-E GLASS	CONVENTIONAL GLASS	PV PANEL
Selective IR Filter	✓	✓	✗	✗
Selective UV filter	✓	✓	✗*	✗
Solar factor/ SHGC	✓	✓	✗	✗
Natural lighting	✓	✓	✓	✗
Thermal performance U < 2 W/m <sup>2</sup> K U< 0,35 BTU/hft <sup>2</sup> F°	✓	✓	✗	✗
Acoustic performance	✓	✓	✓	✗
Electricity generation	✓	✗	✗	✓

	ONYX SOLAR™	LOW-E GLASS	CONVENTIONAL GLASS	PV PANEL
Customized sizes and buildup	✓	✓	✓	✗
Colors	✓	✓	✓	✗
Aesthetic integration in buildings	✓	✓	✓	✗

\* UV filter is only achieved by laminated glass

# PHOTOVOLTAIC ESTIMATION TOOL



In order to calculate the energy generated by your photovoltaic installation we have developed a simple, intuitive photovoltaic-estimation tool. It is available for free on Onyx Solar website, Apple Store and Play Store.

Select the location of your installation, the peak power, the tilt and the orientation and that's all. It also provides useful information such as hours of light generated, CO<sub>2</sub> emissions avoided and even the distance traveled by an electric car with the energy generated by the PV installation. Show the community how sustainable is your building is now possible !

PHOTOVOLTAIC GLASS INNOVATION WALKABLE ROOF  
SKYLIGHT GREENBUILDING BIM ARCHITECTURE LEED  
SUSTAINABILITY PHOTOVOLTAIC BREVIT CERTIFICATION CREDITS  
CLEAN ARCHITECTURE BUILDING WALKABLE ROOF  
ENERGY FROM THE SUN FACADE INNOVATION TECHNOLOGY  
BIPV CANOPY LED ARCHITECTURE CURTAINWALL GENERATION PROJECT PHOTOVOLTAIC FACADE PV ENERGY BUREAU ARCHITECTS  
SKYLIGHT DESIGN BIPV ONYX SOLAR CURTAINWALL LED INNOVATION ARCHITECTURE ROOF LEED BIM BIPV SUSTAINABLE PROJECTS  
PHOTOVOLTAIC GLASS PHOTOVOLTAIC



**UNITED STATES (New York)**

1123 Broadway, Suite 908, NY 10010  
Phone: +1 917 261 4783  
usa@onyxsolar.com

**SPAIN (Avila)**

C/ Río Cea 1, 46 • 05004  
Phone: +34 920 21 00 50  
info@onyxsolar.com



[www.onyxsolar.com](http://www.onyxsolar.com)