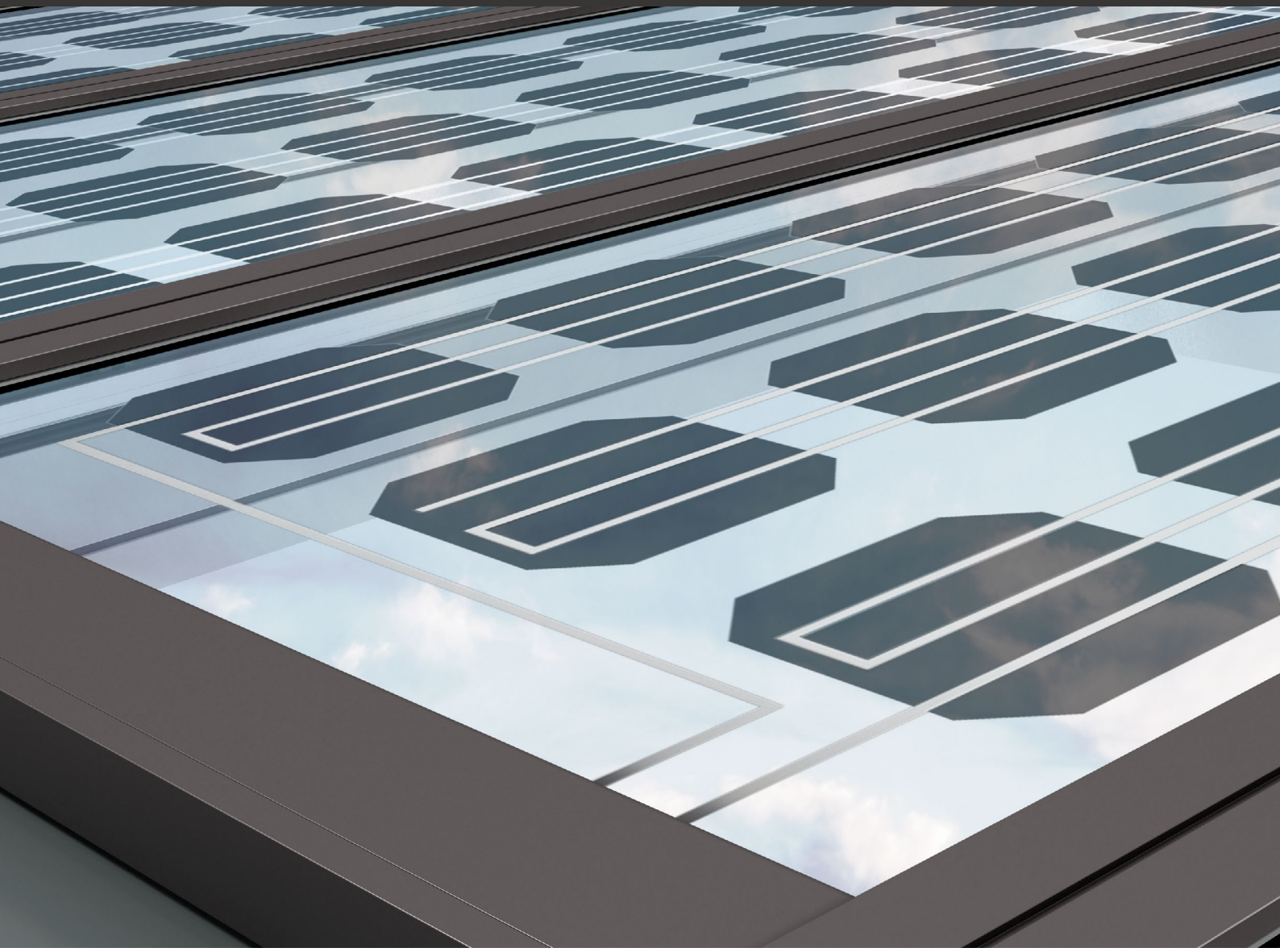
VELUX Modular Skylights

Photovoltaic Glazing Unit

VELUX® Commercial

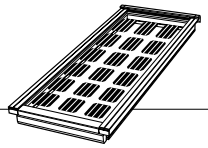


VELUX Modular Skylights with integrated monocrystalline photovoltaics

Modular Skylights are available with built-in photovoltaic cells as a special product. Photovoltaic modules are designed to generate free electricity for the building and its users, creating a valuable supplement to the consumption of conventional power. Modular Skylights with integrated monocrystalline photovoltaics come in a double or triple glazing options. Both photovoltaic options maintain the same low U-value as modules with standard glazing variants.

The photovoltaic cells are black squares approx. 15 x 15 cm evenly distributed over the glazed area of the module. The coverage is project specific, ranging from half to fully covered modules depending on size and customer requirements. VELUX Modular Skylights with built-in photovoltaics are available as both fixed and venting modules within the standard size grid.

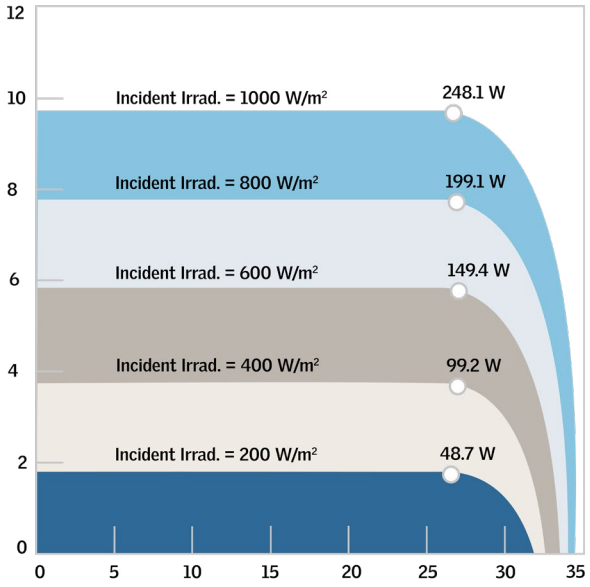
Essential characteristics of the photovoltaic modules

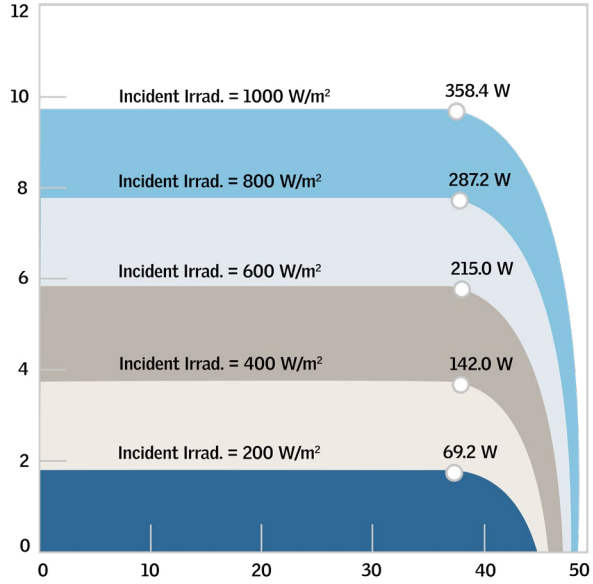


Electrical characteristics - example module size 1000 x 2000 mm				
	Double glazing		Triple glazing	
	Half covered PV IGU	Fully covered PV IGU	Half covered PV IGU	Fully covered PV IGU
Cell type	Monocrystalline 6"	Monocrystalline 6"	Monocrystalline 6"	Monocrystalline 6"
Maximum power [P_{max}]	246 Wp	354 Wp	246 Wp	345 Wp
Module efficiency	up to 12.5%	up to 18%	up to 12.5%	up to 18%
Open circuit voltage [V_{oc}]	34 V	49 V	34 V	39 V
Short circuit current [I_{sc}]	9.41 A	9.41 A	9.41 A	9.41 A
Maximum power voltage [V_{max}]	27 V	39 V	27 V	39 V
Maximum power current [I_{max}]	9.10 A	9.10 A	9.10 A	9.10 A
Maximum system voltage	1000 V DC	1000 V DC	1000 V DC	1000 V DC
Tolerance	± 10%	± 10%	± 10%	± 10%
Temperature coefficient current T_{cI}	+0.07 %/°C	+0.07 %/°C	+0.07 %/°C	+0.07 %/°C
Temperature coefficient voltage T_{cV}	-0.28 %/°C	-0.28 %/°C	-0.28 %/°C	-0.28 %/°C
Power temperature coefficient T_{cP}	-0.32 %/°C	-0.32 %/°C	-0.32 %/°C	-0.32 %/°C
NOCT (800 W/m² , 20°C, AM 1.5, 1m/s)	48 °C	48 °C	48 °C	48 °C

Qualification parameters - example module size 1000 x 2000 mm				
Operating temperature	85% RH, -40 –> +80°C	85% RH, -40 –> +80°C	85% RH, -40 –> +80°C	85% RH, -40 –> +80°C
Maximum load IEC	5400 Pa	5400 Pa	5400 Pa	5400 Pa
Application class	A	A	A	A

Physical characteristics - example module size 1000 x 2000 mm				
Number of cells	50	72	50	72
T_v (ca. %)	37	9	37	9
Distance between cells	26 mm / 37 mm	3 mm	26 mm / 37 mm	3 mm
Encapsulant	EVA	EVA	EVA	EVA
Glazing construction (outside to inside)	5T - PV cells - 5T - 14 Argon - 8.76HS LowE (44.2)	5T - PV cells - 5T - 14 Argon - 8.76HS LowE (44.2)	5T - PV cells - 5T - 10 Argon - 6T - 10 Argon - 8.76HS LowE (44.2)	5T - PV cells - 5T - 10 Argon - 6T - 10 Argon - 8.76HS LowE (44.2)
Ug (W/m²K)	1.1	1.1	0.7	0.7
g (ca. %)	22	6	18	4
Connecting cables	MC4 compatible	MC4 compatible	MC4 compatible	MC4 compatible
Number of by-pass-diodes	3 (2)	3 (2)	3 (2)	3 (2)





Irradiance Dependance				
[W/m²]	1000	800	600	400
Isc	0%	-19.6%	-39.5%	-59.2%
Voc	0%	-1.38%	-3.05%	-5.90%

* Under Standard Test Conditions (STC) of irradiance of 1000 W/m², spectrum AM 1.5 and cell temperature of 25 °C

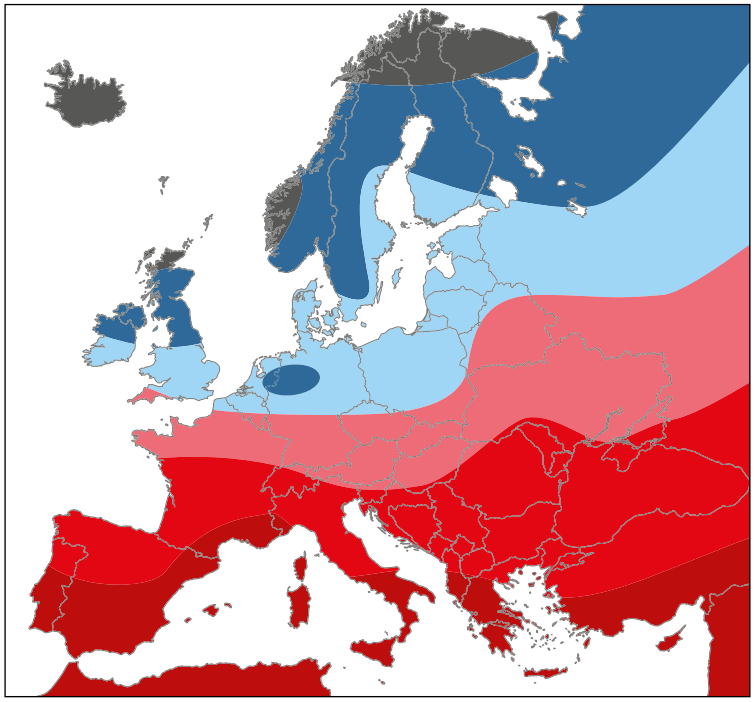
Photovoltaic installation

In order to achieve the optimum performance from the photovoltaic modules a crucial step is the design of the photovoltaic layout on the roof – preferably tilted towards the equator in a shadow-free environment and as a rule of thumb at an angle that equals **the latitude minus 10%.**

As for cleaning the requirements are no different than for modules with standard glazings.

For more information on cleaning, please see the Maintenance and Cleaning Guide

Electricity performance on photovoltaic solar panels in European countries



Map legend:

Global irradiation on optimally tilted south-oriented photovoltaic modules (kWh/m² per year)

1000 1200 1400 1600 1800 2000

750 900 1050 1200 1350 1500

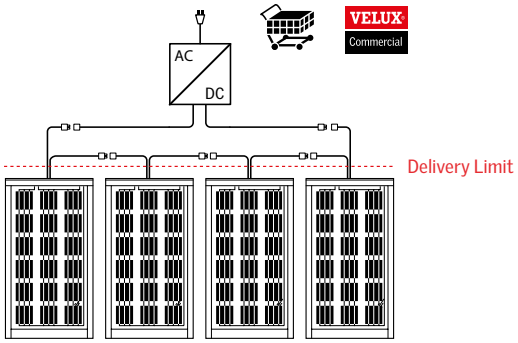
Solar electricity generated by 1000 Wp PV-system with optimally tilted modules and performance ratio 0.75 (kWh/1000 Wp PV per year)

Installation

Photovoltaic connection
The photovoltaic modules are nearly always connected in series, also called strings, in order to build up the wanted voltage. The strings are then connected to an inverter.

The inverter, also called DC-AC converter,, converts the direct current (DC) coming from the photovoltaic modules into alternate current (AC) in order to make the electricity usable in the same manner as the electricity from the grid.
(Deutsche Gesellschaft für Sonnenenergie 2005)

The size of the inverter depends on the size of the photovoltaic installation. The inverter and all cables connecting the inverter to the skylight modules are not supplied by VELUX Commercial. The electrical contractor is responsible for choosing the correct inverter. The interconnection of the modules must be done by an authorized electrician.



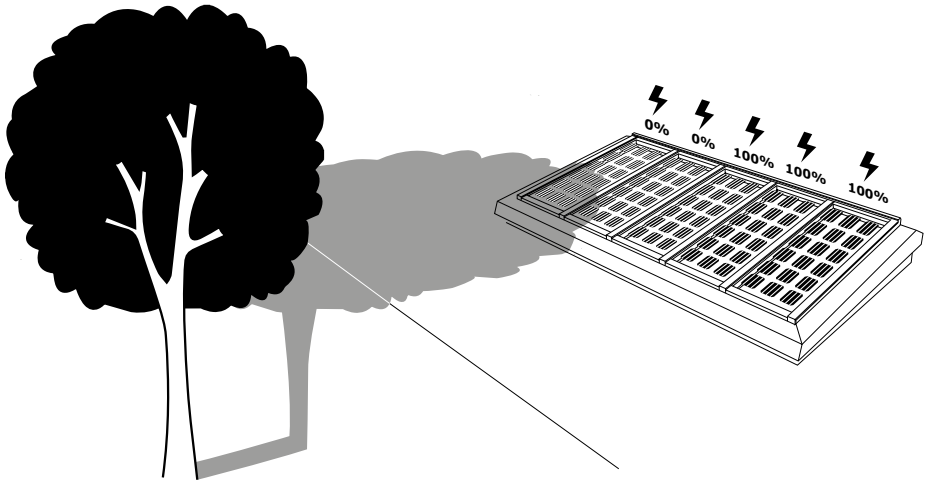
In a string, all photovoltaic modules must produce an identical amount of electricity. If a photovoltaic module produces less electricity than the surrounding modules it could potentially weaken the whole module string – an analogy here could well be a long water hose when squeezed in just one place limits the water transport in its whole length.

In order to prevent one shadowed module to weaken a string entirely, each module is equipped with two or three by-pass-diode that allow the electricity flow to by-pass the inefficient module. This means that this certain module would not contribute to electricity production, but would not limit it either as shown below.

This issue about serial connection between the modules requires several significant precautions for the installation and skylight photovoltaic modules:

1. All modules in a string must have the same size.
2. All modules in a string must have the same orientation and installation pitch.
3. All modules in a string must have the same shadow conditions from surrounding objects.

Principle drawing



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