

A future with photovoltaic power

State of the art technology for the world market



SCHOTT
solar



Powered by the Sun



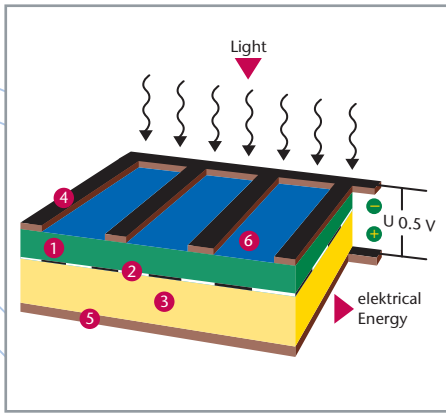
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Opportunities and visions: The enormous potential of solar power

The sun is a gigantic powerhouse. The amount of solar energy captured by the earth in the space of just a few days is enough to meet the world's entire primary energy requirements for a whole year. Researchers have always dreamed of being able to harness this potential. Their vision is about to become a reality.





Function of a Solar Cell
 1. n-type silicon
 2. p-n-junction
 3. p-type silicon
 4. Front side contact
 5. Back side contact
 6. Anti-reflexion coating



There would be no life on earth without the sun. Researchers have long sought ways of exploiting this free source of energy for mankind. They have now achieved that goal – and by helping to drive the development of the photovoltaic industry forward, our company has played a key role in that success story from day one.

Energy for everyone

The inexhaustible source of energy provided by the sun is likely to make an ever greater contribution to ensuring a sustainable supply of power for human needs. Environmentally friendly, universally deployable and geared towards the future. Solar power plants will give millions of people in developing countries their first opportunity to meet basic needs such as light, education and health care, taking them a step closer to sharing the benefits of technical progress. For energy is the cornerstone of all development. And the sun is available to everyone, everywhere.

First used in space

In 1839, the physicist Edmund Becquerel discovered the photovoltaic effect: the direct conversion of light into electricity. But the real breakthrough in solar research did not come until the 1960s with the development of space travel. The spacecraft required an ultra-

reliable, autonomous, lightweight supply of energy. Solar power was the ideal solution. This led to the typical solar sails which are still very much state of the art today. The development of these highly efficient cells was entrusted to a handful of companies including AEG-Telefunken, which was subsequently absorbed by Deutsche Aerospace (DASA). The precious know-how accumulated by both these companies has now transferred to SCHOTT Solar, providing a solid base from which to search for solutions with a bright future.

Proven practical benefits on a global scale

Following on from the enduring success of long-term solar technology in space, the challenge was to find a way of exploiting this technology on earth, too. This began with small applications such as solar-powered pocket calculators which no longer needed a battery. In the 1980s solar power plants first came into use – primarily in the USA – as an autonomous source of energy for remote houses whose inhabitants were keen on finding an environmentally-friendly alternative or addition to their diesel generators. In the 1990s, government sponsorship programmes provided a further boost for demand in a few key countries.

The simultaneous advent of industrial series production facilities also triggered a substantial reduction in manufacturing costs, leading to further market expansion. Combining both economic and ecological benefits to optimum effect, photovoltaics is widely regarded as a technology with a highly promising future. Depending on the installation site, the energy payback period of solar power modules is between 3 and 7 years, i.e. much less than the 30-year service life our modules should provide. We at SCHOTT Solar continue to focus on optimising these advantages.



With our unique EFG Wafer production process we are able to save Silicon material and hence reduce the energy pay back time of our products.

Competence and quality: SCHOTT Solar enjoys worldwide success

SCHOTT Solar is the largest manufacturer of photovoltaics components in Europe and No. 5 worldwide. Satisfied customers all over the world place their trust in the first-class performance and durability of our products. The name SCHOTT Solar stands for innovative strength and quality.

A tradition of quality

Our company has a strong shareholder: SCHOTT AG, Mainz. SCHOTT AG is a world leader in the manufacture of glass for special applications. Our shareholder has already been in the market for over 100 years and has established a solid international presence.

As a joint venture, we tap into the forty years plus of experience acquired by our predecessor firms: AEG Telefunken began researching and producing sophisticated solar cells for use in space as long ago as 1960. Over 300 satellites have been equipped with our solar technology. Research, development and innovation have played a primordial role in our operations for over 40 years.

The largest fully integrated solar factory in Europe

SCHOTT's head office is located in Germany, at the heart of Europe. In Alzenau, on the outskirts of Frankfurt, we operate the largest and most innovative fully integrated production in the whole of Europe, our SmartSolarFab®. Besides our equally integrated production site in the USA, we manufacture ASI® thin-film modules in an industrial scale in Putzbrunn. The interdisciplinary experience gleaned from these sources helps us in the pursuit of our ambitious goal: quality at the highest level.

Profitability and durability

Our solar modules are designed to deliver the highest possible energy. Tests conducted by various independent institutes and specialist media from different countries provide impressive confirmation of this. We know that operators of photovoltaic plants expect the modules to function reliably for over 20 years.

Our uncompromising attitude to quality means we can give a reliable extended performance guarantee on our products, making us a dependable partner for anyone who wants to put this fascinating technology to profitable use with confidence.





1958

AEG starts to develop photovoltaic systems for space travel.

1964

Basic development by AEG of silicon solar cells for terrestrial applications. Production starts in Heilbronn a year later.

1973

Mobil Tyco Solar Energy develops the EFG solar cell.

1979

Development of a thin-layer compound semiconductor by NUKEM (Cu₂S/CdS).

1980

Development work on thin-layer solar cells by MBB (a-Si).

1988

Creation of Phototronics Solartechnik (PST).

1994

DASA and NUKEM set up Angewandte Solarenergie – ASE GmbH. ASE Americas Inc. is established.

2002

The RWE SCHOTT Solar joint ventures is established along with RWE Space Solar Power GmbH. Production starts at the SmartSolarFab® facility in Alzenau.

2004

SmartSolarFab® is extended to 100 MW; 40 MW module production unit is set up in the Czech Republic.

Forward-looking and environmentally aware: Grid-connected applications

In areas with a well developed grid, the construction of solar power plants is usually encouraged to increase the percentage of renewable energy in the region, thereby providing a sensible emission-free addition to the conventional power station mix. These solar power plants feed environmental friendly electricity into the electricity grid.





Your roof: a mini powerhouse

Most grid-connected systems are designed for sloped rooftop installation. Optimally the roof should be oriented towards the sun between south-east and south-west. But installation on flat roofs or even freestanding on open ground is also possible.

Simply ingenious

The system comprises a number of interconnected solar modules designed to convert ambient sunlight into direct current. This is then changed into alternating current by an inverter and fed into the grid. Over the course of a year a PV system which fits on the south-oriented roof of a typical private home can produce 2500 to 5000 kWh of electrical energy, depending on the region and amount of sunshine. The output will usually be substantially higher in southern countries.

This is equivalent to the annual power consumption of a three to four-person family. The number of previously unexploited roofs now being turned into mini decentralised power stations is growing all the time.

For information on Solar Thermal products from SCHOTT please visit www.schott.com/solar.



For roof-top or roof-integrated systems replacing roof tiles or for innovative building facades, we can offer you the right product.



Permanent gains

A solar power plant will generate electricity the whole year round. And not just in brilliant sunshine,

but on cloudy days, too. The yield will ultimately depend on the amount of ambient sunlight. In regions such as Germany, Spain or Korea, where the statutory payment for electricity fed into the grid is higher, the entire yield is usually fed into the grid. The remuneration received by the operator is usually enough for the system to pay itself off and supply a reasonable income in addition. The operator continues to source his own power requirements from the grid. In other regions such as the USA and Japan, for example, the operator receives an investment subsidy or interest reduced loans and uses most of the power generated to meet his own energy requirements. In this case, the reduction in electricity bills also justifies the cost of installing a solar power system.

Whatever the situation, investors can be confident that when they opt for solar modules by SCHOTT Solar, they can expect a guaranteed long-term yield. This is a critical factor when calculating the economic viability of a solar installation.

Solar power plants set the trend

Economic viability is often a secondary consideration for many private users and companies. Installing a solar power plant is an active way of promoting the use of clean, emissionfree power technologies and visible proof of commitment to an innovative, forwardlooking, environmentally aware philosophy.





Innovative and aesthetically pleasing: ASI® for facades and overhead glazing

Besides our modules for roof-top or roof-integrated systems we can offer you our ASI®-modules for the integration into building facades and for overhead glazing applications. In this case the solar modules become a multifunctional construction material with the capacity to assume a range of other functions in addition to pure power generation.

Our ASITHRU® glass is an ideal product for the special requirements of applications integral to the building: semi-transparent thin-layer modules with a fine line structure where the amorphous silicon solar cells are integrated in top quality insulating glass.

Multifunctional value

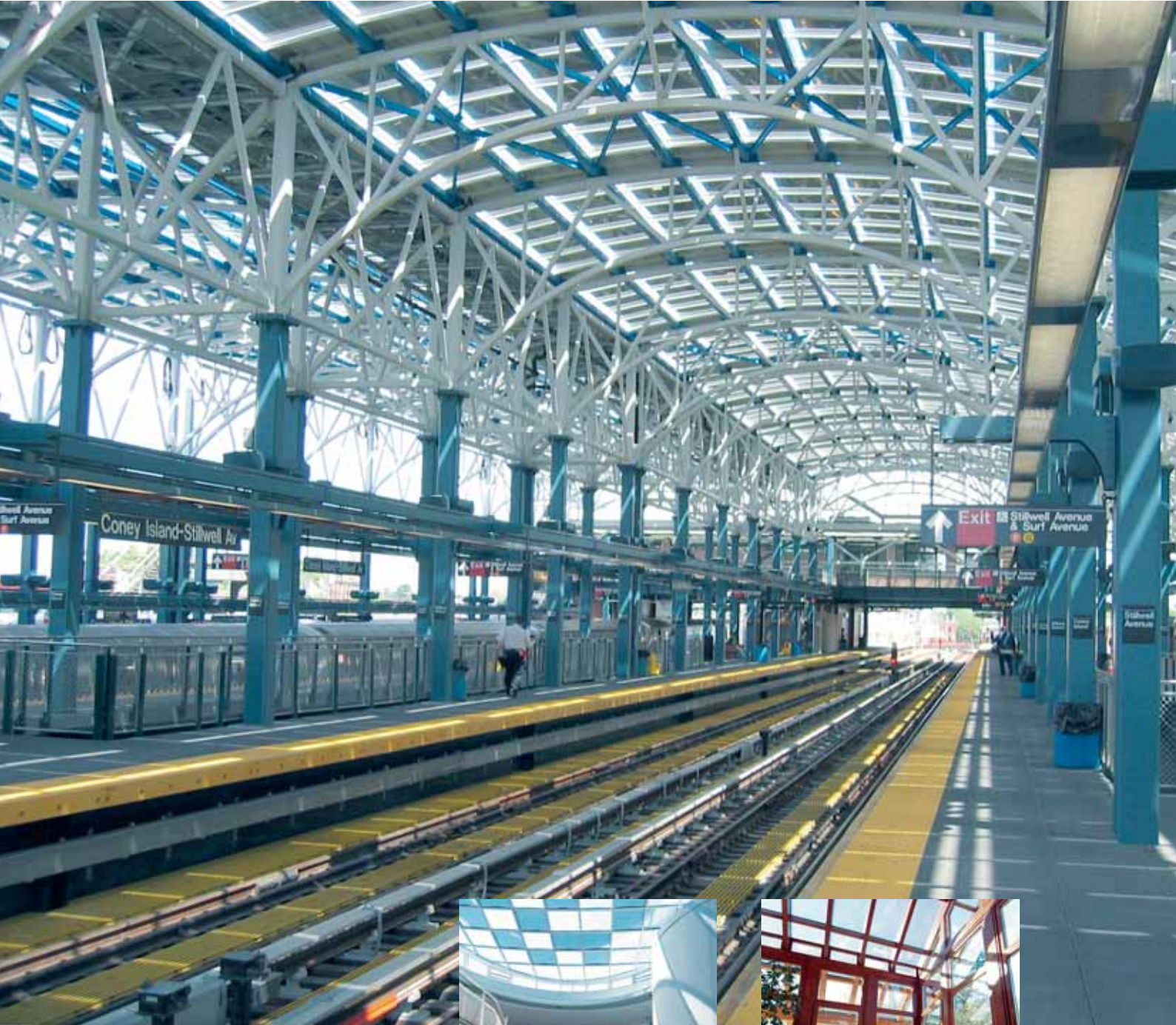
In contrast to modules which are installed on a support, the ASI® elements actually become part of the building structure, and can therefore fulfil additional tasks: thermal insulation, protection against the outside elements and screening. Glass is a recognised weatherproof building material that guarantees full heat insulation. ASI® glass provides screening wherever permanent protection against the sun is required, often in combination with transparent glass. Our experience of ASI® glass has been very positive. Our customers are fully satisfied with the systems, some of which have been in operation for over ten years.

The advantages for building contractors are obvious: the glass elements perform functions which need to be assured anyway, whilst generating electricity at the same time. The multifunctional quality of the modules saves costs elsewhere. There is often no need to invest in an external screening system, for example, and smaller air-conditioning units will suffice. The ASI® modules can also be combined with high-performance crystalline roof systems.

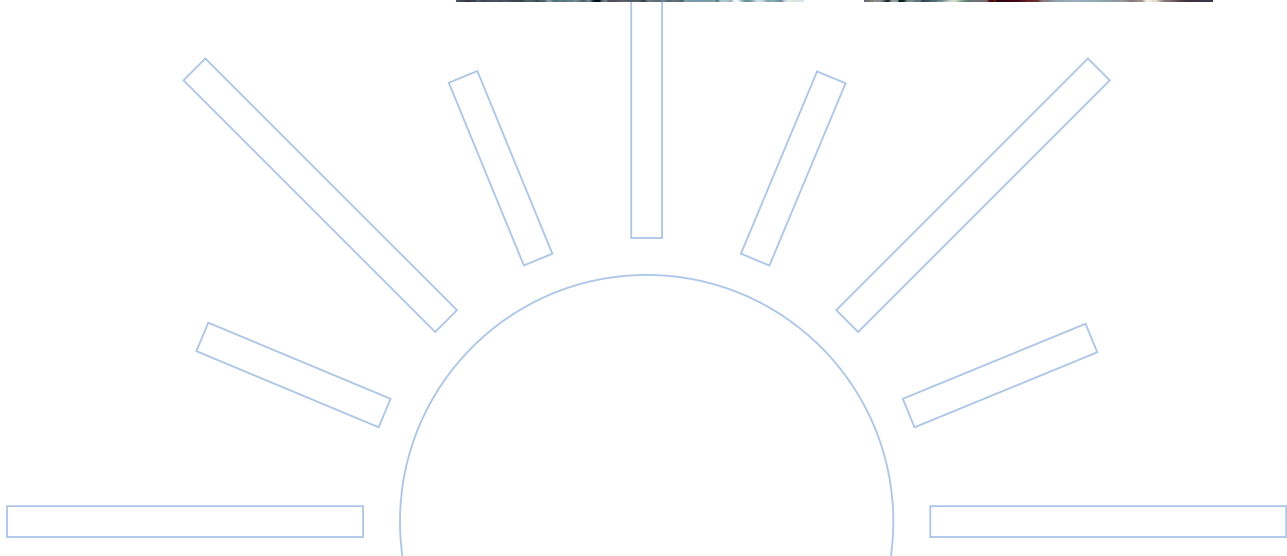
High visual appeal

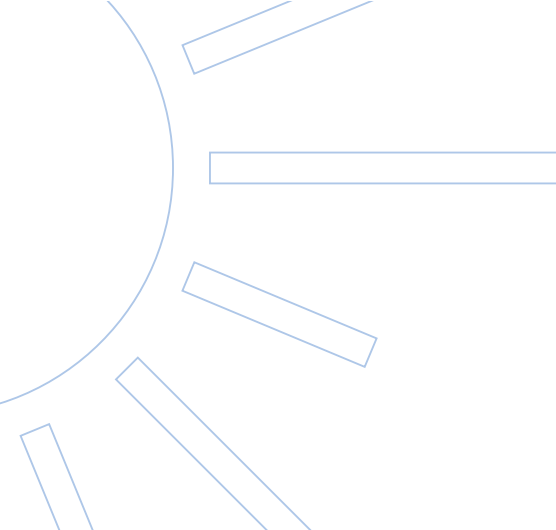
Design is another advantage of integral solar power systems. The material allows architects to combine function and good looks to optimum effect: glass surfaces integrated in the facade or roof of a building make superb design elements. With this in mind, we supply ASI® glass in a variety of finishes, from solar power modules with differing degrees of translucence through to coloured components. This gives planners ample scope for creativity whilst building contractors can underline their commitment to innovative, energy-saving construction methods. This is without doubt an application with a great future.





Besides our semitransparent ASITHRU® modules we can offer you for your building shell our ASIOPAK® modules with various designs. Also custom specific designs can be realized.





Efficient and flexible: Autonomous solar power systems

In many parts of the world local electricity supply is not available, yet. An off-grid solar electric solutions is in many cases the only solution, especially when connection with the grid would be too expensive or technically impossible.





It is estimated, that about 2 billion people world-wide are still living without electricity. A central power supply often times is not possible in those regions. Accordingly decentral modular scalable solutions are requested. In many regions off-grid solar electric systems with battery back-up are the right choice.

Solar energy as a stabilising socio-political factor

The advantages of such island solutions are now appreciated around the globe – not least because of the political benefits in terms of development: electricity is essential for education and a higher standard of living. Electricity enables communication and economic activity. It brings comfort to our daily lives. No wonder, then, that in countries with energy supply insufficiencies, electrification is high on the list of development measures for underdeveloped rural areas. However, electrification with conventional technologies is often expensive and uneconomical, especially in geographically vast countries and remote areas. It may even prove impossible to set up a functioning distribution network. Island solar power systems provide an effective solution. Their high degree of modularity is a big advantage in that systems of any



Off-grid solar electric systems have many advantages compared to diesel generators or other autonomous systems: They do not need to be supplied with fuel, they need much less maintenance, they are more reliable and quiet. Calculated over the lifetime of the systems, they are economically in most cases the best choice.

size can be installed – at reasonable cost. The options range from simple solar home systems to power individual houses through to mini-grid set-ups to ensure a centralised power supply for, say, a village or to stabilise existing networks. As most people who do not yet have electricity live in countries with above average hours of sunshine, the solar solution would appear to be an ideal means of providing power and an opportunity to gradually improve living standards.

Experience and cooperation around the globe

SCHOTT Solar has installed this kind of off-grid system in numerous countries, often in close cooperation with local government representatives. Our know-how extends from standardised solar home systems through to complex systems to provide a decentralised power supply. And even in the climatically challenging environments of tropical and subtropical countries, our top quality modules have been proven reassuringly reliable, day after day.





Roof-top



Roof integration



Facade integration

Consistent customer focus: The SCHOTT Solar product range

There are many uses for solar power. Each application goes hand in hand with a specific set of customer needs: from innovative facade systems and optimum yield megawatt systems through to power supply technology for small appliances and reliable systems for powering entire villages – SCHOTT Solar has the right quality products for any customer requirements.



Ground-mounted

Crystalline ASE® solar power modules, from 50 W to 300 W

Durable, high-yield modules for grid interconnection or autonomous off-grid systems, for retrofitting on pitched roofs, flat roofs and outdoor sites.

InDaX® PV roof systems

Solar power modules for integration in pitched roofs, for private customers seeking a firstclass aesthetic solution, easy to install, high yield, extremely reliable.

ASI® thin-layer modules

Customer-specific solar power modules in amorphous silicon as a multifunctional building element for innovative building design (ASITHRU®, ASIOPAK®), as the smallest possible module for electronic indoor and outdoor applications and as a framed standard module.

Crystalline solar cells

Solar cells made from multicrystalline wafers (Main) and EFG wafers (EFG).

We hope we have made you more curious about this fascinating technology and its wide range of applications.

Please visit us on the internet at

www.schott.com/solar

or give us a call at

+49 (0) 6023 91 1712

We would be very pleased to help.

SCHOTT Solar GmbH Figures

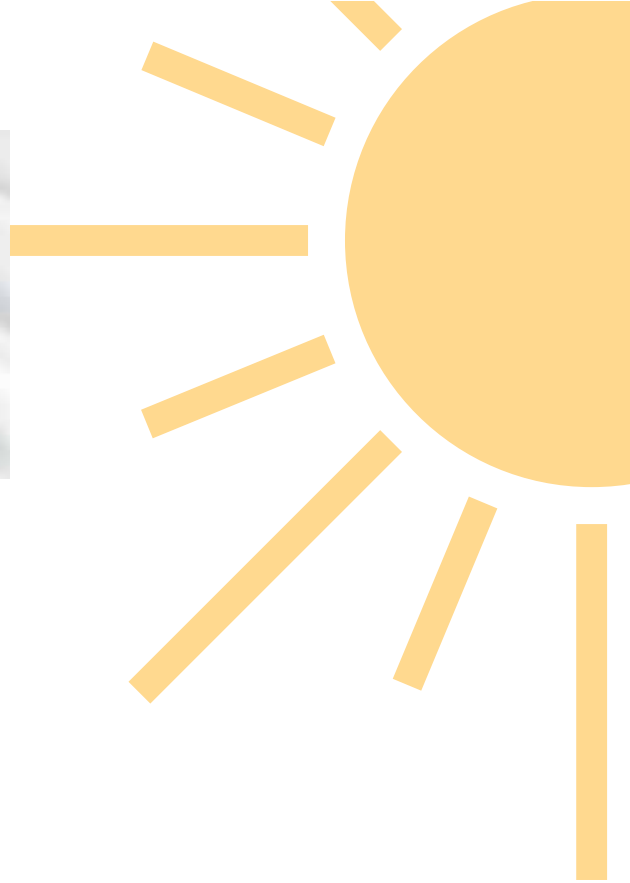
Sales 2005:	ca. € 285 million
Employees 2005:	ca. 900
Cell capacity:	ca. 130 MW



Off-Grid



Consumer



SCHOTT Solar GmbH at a glance



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