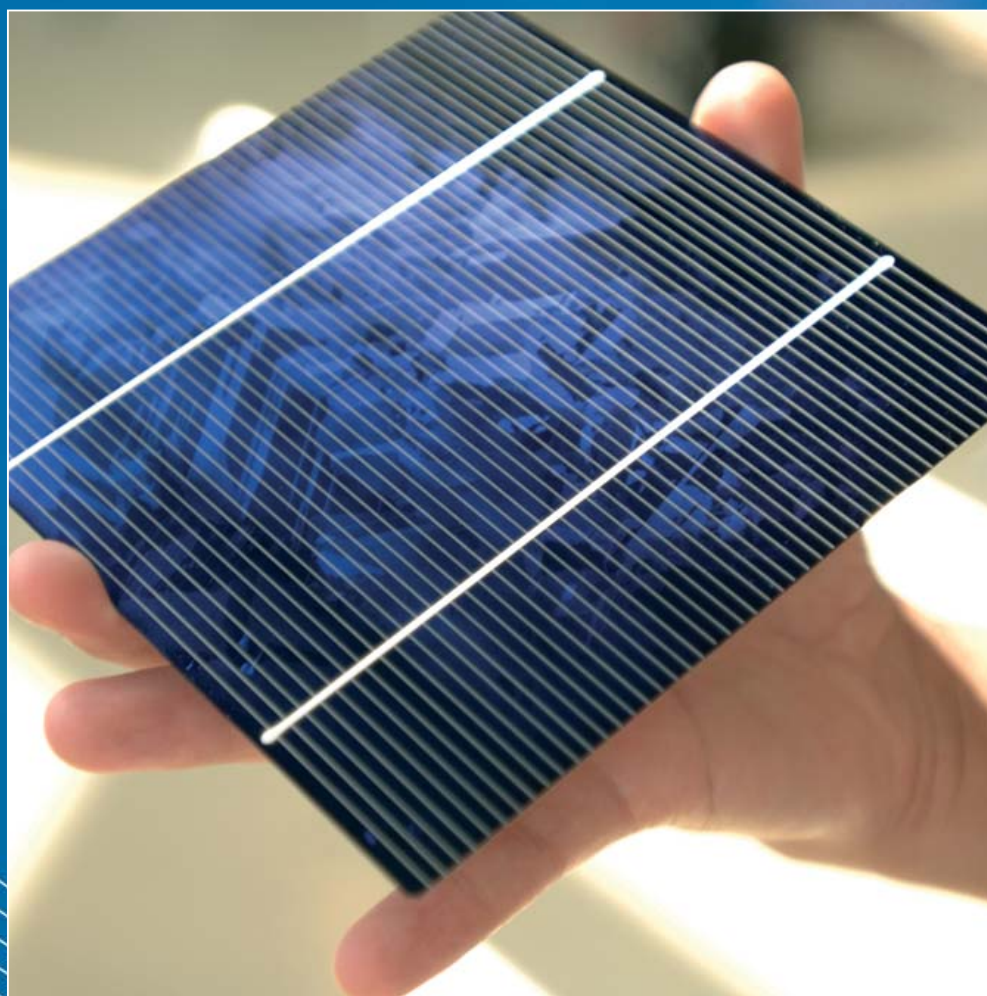


# Quality through Experience – Security for the Future

Top Quality and Long Life Span  
for High Energy Yields



**SCHOTT**  
solar

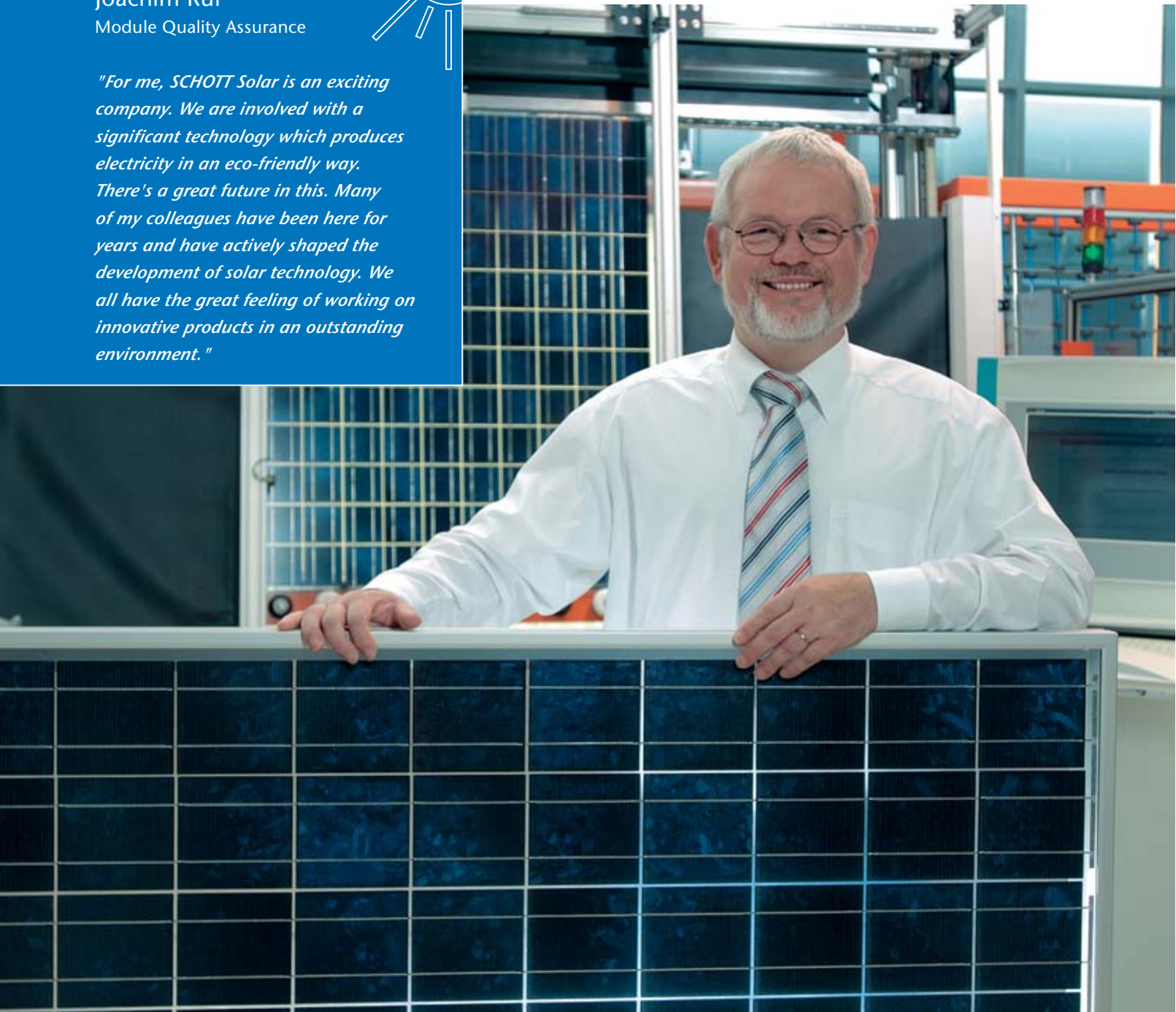
# Years of Experience and Expertise – Security Worth your Confidence

SCHOTT Solar has decisively influenced the development of solar technology – unlike many new providers who are pushing into this future market. Our long experience and the innovative strength of our products have earned us a reputation for being a reliable manufacturer in every respect. Our customers have valued these qualities for 50 years.

Joachim Ruf  
Module Quality Assurance



*"For me, SCHOTT Solar is an exciting company. We are involved with a significant technology which produces electricity in an eco-friendly way. There's a great future in this. Many of my colleagues have been here for years and have actively shaped the development of solar technology. We all have the great feeling of working on innovative products in an outstanding environment."*





*What has proven itself in space is now being used successfully on Earth.*

Quality, performance and longevity are essential preconditions for the economic profitability of a solar power system. That's where we come in.

**Because we believe in our success formula:**

**yield = life span x performance**

#### **Since 1958 - we've been there from the start**

Back then, the development of increasingly efficient cells for the world market was in the hands of only a few companies. These included AEG Telefunken, which later became part of the aerospace company DASA. In 1978, AEG in Wedel, near Hamburg, was the first company in Europe to start the industrial serial production of solar power modules.

This valuable expertise from both companies flowed into SCHOTT Solar AG. Our solar technology has proven itself in over 300 satellites. As pioneers of photovoltaics we have remained loyal to our tradition of research and have consistently optimised our products over the course of 50 years' experience. We didn't just jump on the bandwagon. We've been on this journey from the start - in the driving seat.

#### **Subsidiary of the technology company SCHOTT AG with over 125 years of history**

SCHOTT Solar AG is a fully-owned subsidiary of SCHOTT AG, a company rich in tradition. SCHOTT AG has recognized the potential of photovoltaics and made substantial investments in this important sector of the future.

SCHOTT AG is an international technology company which sees the sustainable improvement of living and working conditions as its core mission. To achieve this, special materials, components and systems are being developed. Its main focus is in the areas of domestic appliances, optics and electronics, pharmaceuticals and solar power. With manufacturing and sales operations in every major market, SCHOTT AG is always close to its customers. Around 16,800 employees produce a turnover of just about 2,23 billion Euros worldwide. The company's technological and economic expertise is combined with its commitment to social and ecological responsibility.

#### **Dual benefit for customers: quality and experience**

At the Otto Schott Research Centre in Mainz, one of the world's most modern glass research operations, as well as in Duryea, Pennsylvania (USA) and in many more of SCHOTT AG's development laboratories, over 800 highly qualified personnel are developing new products, as well as the materials, technologies, production plants and systems required for their manufacture. Every single customer who buys a SCHOTT Solar AG product benefits from this in-depth expertise.

Apart from solar power modules, the SCHOTT Group also produces receiver pipes for solar thermal power plants. Similar to photovoltaics, solar thermal technology has been growing apace for years.

SCHOTT Solar AG: already on the market for 50 years and a reliable partner for the future.

**Proved and tested a thousand times over: modules with a total output of more than 400 MWp in use worldwide!**

# Strict Quality Management: Top Quality Products with Maximum Life Span

Independent international benchmark tests are evidence of our successful work. To be a market leader in a future technology such as photovoltaics, we have to make an unconditional commitment to quality - be it in terms of development, manufacture or service. Every single product we make is the result of this successful philosophy.

Joachim Fölsch  
Head of Quality Assurance



*"Hardly anyone can imagine the enormous lengths to which we go to assure the quality of our products. For us, quality starts with the careful selection and testing of all raw materials and runs through the entire manufacturing process. We deliberately go way beyond the industry's strict standards. A surface load of more than half a ton per square metre is a case in point. Nobody needs to worry about a winter with heavy snow."*





Our modules are designed in such a way that they can stand up to even extreme weather conditions, such as heavy snow loads.



### Extremely resilient: 550 kg per square metre

Our crystalline modules have been tested for an increased pressure and suction load of 5,400 Pascal (Pa) and can therefore stand up to a surface load of 550 kg per square metre. This means top level security for your investment, even in the event of strong winds or heavy snowfall.

### Industry standards are not enough: doubly strict quality control

- Every single silicon wafer, every solar cell and every module is thoroughly tested. There are several quality control checks at all stages of production.
- Of our own choice, we have drastically upped the high test criteria laid down in IEC 61215. The requirements on our products in our climate tests are double those of standard climate tests. This makes our modules particularly reliable in continuous operation.

**EXAMPLE: PV-PLANT  
FRAUNHOFER INSTITUTE  
IN FREIBURG**

**Solar electricity module:**  
PQ 10/40/01

**System power:** approx. 2,3 kWp

**Year of installation:** 1986

- Modules in continuous operation for more than 20 years
- Tried and tested quality bringing returns
- Performance stability proven by independent performance tests

### SCHOTT Solar = Standard test (IEC) x 2

SCHOTT	
IEC	
DampHeat Test	→ IEC + 1.000 h = SCHOTT Solar
1.000 h = IEC	
ThermoCycle Test	→ IEC + 200 cycles = SCHOTT Solar
200 cycles = IEC	

### SCHOTT Solar modules are outstanding:

- Stress-relieved soldering technology during module assembly
- Optimum combination of high quality materials and components
- Reliability, even when exposed to extreme climatic conditions.
- Wide distance of cells from the frame reduces overshadowing by the frame.

### Double glazing for a long life span

- Embedding the cells between panes and glass makes for a symmetrical, long-lived and robust module design
- Particularly long life span
- The glass is resistant to chemical gases. Our double-glazed modules are therefore often used in agricultural buildings.

**That's why our products are outstanding: years of reliable use from every single module.**

# Solar Modules are a Small Power Plant: High Performance and Excellent Yields

We have helped to shape the rapid development of solar technology and have consistently backed performance. Within the first hour of operation this starts paying dividends for long-term operations. The optimisation of every single process step and the combination of individual materials in the finished solar module significantly influence yields. This can be shown by many examples.



## High level of automation

SCHOTT Solar has long experience in the selection and combination of materials. We exclusively use materials (primary materials and components) from quality manufacturers and subject them to strict incoming goods inspection.

At our locations state-of-the-art production equipment is in operation. We control all parts of the value chain - from wafer to finished module. In this way we can ensure optimum control and monitoring of each step along the way and ensure highest quality.

## EXAMPLE: PV-SOLAR POWER SYSTEM IN MUNICH WITH HIGH PERFORMANCE RATIO



### Solar electricity module:

1600 x ASE-100-GT-FT

System power: 160 kWp

### Solar power production:

approx. 160,000 kWh/a

### CO<sub>2</sub> emission avoided:

approx. 85,000 kg/a

Performance ratio\*: approx. 84 % („normal“ average 75 – 80 %)

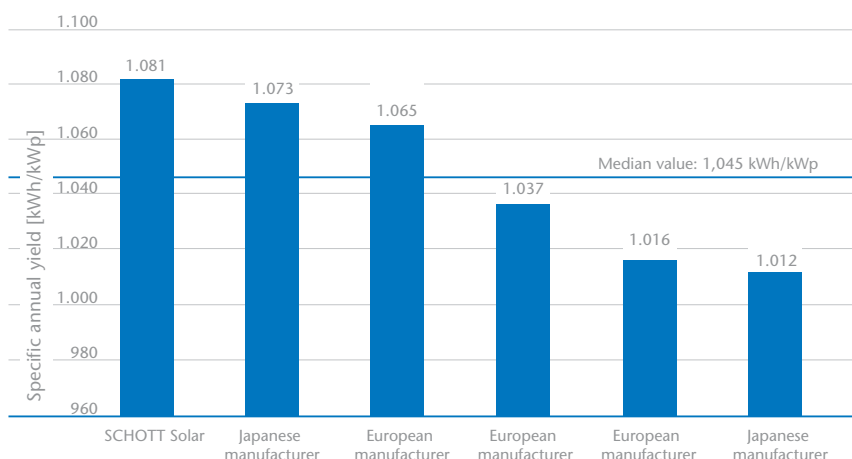
Source: MHH Solartechnik GmbH

*\*In photovoltaics „performance ratio“ refers to the relationship between a system’s actual and its maximum possible energy yield under standard test conditions. With our solar power modules top ratings can be achieved.*

## Solar cell production - an innovative process

- Every solar cell is manufactured in a highly automated line process. This makes it easier to efficiently monitor quality, and ensures high repeatability.
- The unique finger structure (accumulators on the upper side of the cell) increases the energy yield.
- The dark anti-reflective coating guarantees high light efficiency.

Long-term satisfaction with your solar power system is largely dependent upon the yield and life span of your solar modules.



The convincing result of this study from 2003 showed in practice that SCHOTT Solar achieved significantly higher yields. This was persuasively demonstrated in the statistical evaluation of several hundred installations in southern Germany.



## Annabell Schopf

Sales



*"Customers have high expectations of our products. Because they know that test results always put us right at the top. For operators, a PV system is an investment which should bring in a good return. That's why it's so important to us to assure the modules' long-term performance. We have continuously improved the performance of our cells and modules using many of our own developments."*

### **High customer satisfaction with SCHOTT Solar products**

Our customers tell us again and again that they recommend SCHOTT Solar modules with a clear conscience. The last two customer satisfaction surveys are evidence of this: over 90 % of the customers questioned said they were more than satisfied with SCHOTT Solar. That's a vote of confidence for us and at the same time, it underlines our obligation to continue improving our products and service.

### **Tried and tested - a thousand times over**

The fact that our company has been successful for so long and has invested millions of Euros in innovations, reassures our customers. In practice it's

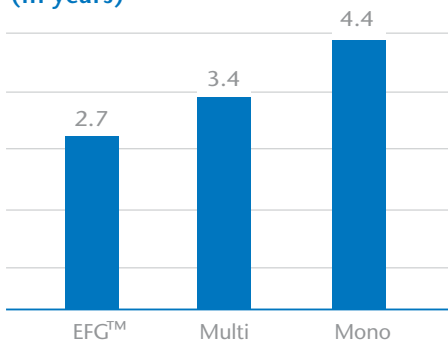
been proven a thousand times over: you can rely on the durability of our products and their stable performance. In all weather conditions.

**We are constantly optimising our manufacturing processes with innovations. In this way, we are continuously increasing our products' life span, efficiency and energy yield.**

# Innovation and Responsibility: Future Technology Today

SCHOTT Solar offer modules of varying design and performance. All have one thing in common: they are always innovative industry products, designed with our customers' needs in mind. All of the cells used in our modules are produced at our highly efficient SmartSolarFab® in Alzenau. "Made in Germany" to the highest standard. German know-how that's going places.

Results of the EU commission's "Crystal Clear" project on PV module energy payback period (in years)



During a performance period of 25 years, our EFG™ modules produce around ten times as much energy than was required for their manufacture. This is a convincingly positive energy balance and an active contribution to environmental protection.

### A plus point for the ecological balance sheet: the EFG™ process

We have developed a technology which is particularly sparing of resources for the manufacture of thin silicon wafers needed for cells: the EFG™ process. It is recognised in expert circles worldwide.

### Forward looking: innovative patent

The silicon comes out of the smelter in the shape of hollow tubes with 8 to 12 corners. These are then separated into individual wafers by means of lasers.

### Saving of resources: hardly any material losses

In contrast to traditional wafer manufacturing methods, which involves considerable material losses, the EFG™ process results in little waste, almost 100 % of which can, in turn, be recycled. That saves valuable silicon.

### Ecologically advantageous: short energy return time

To evaluate the eco-friendliness of a product, the energy required for its manufacture is compared with the energy it produces. Thanks to the environmentally friendly manufacturing process, this "energy payback period" (see chart on left) is satisfyingly short.

*A plus for the ecological balance sheet: EFG™ manufacture succeeds in saving valuable silicon.*





**Mike Lorenz,**  
Electrical Engineering  
Master Technician &  
Solarteur Environmental  
and Energy Technology,  
Gründau



**Customer statement:**

*"My company has been working successfully with SCHOTT Solar products for years. Naturally, this is not by accident. I am fully convinced of the outstanding quality of SCHOTT's solar modules. I am impressed by the enormous lengths SCHOTT Solar go for the development and production of their solar modules. Who of the other manufacturers can claim this for their own products? Utmost diligence is important to assure our clients that the modules will achieve continuously good performance for many years and in all weathers. And this is crucial for the yield of a solar power system. That's why I can recommend SCHOTT Solar's solar modules to my customers with a clear conscience."*

**All modules are not equal - tested and proven quality**

An essential factor for calculating return is the number of kilowatt hours (kWh) of energy the solar power system delivers on a sustained basis per installed kilowatt peak (kWp). However, this yield is dependent on the performance and reliability of the modules. Tests carried out by independent institutes show there are big differences to be found here. Our modules fulfil the highest quality criteria and in independent tests reliably rank at the top. Find out for yourself:

- LEEE (Laboratory of Energy, Ecology and Economy)-TISO
- University of Oxford (study)
- Stiftung Warentest (Consumer Goods Testing Foundation)
- Test results: Fraunhofer Institute ISE



**Our goal is durability: we don't just want to be good, but significantly better. So that you have better returns.**

**SCHOTT SOLAR –  
NATURALLY WITH  
CERTIFICATION**

- DIN EN ISO 9001:2000 attests to our stringent quality management system.
- ISO 14001:2005 certifies that we operate a responsible environmental management system.



MANAGEMENTSYSTEM  
DQS-zertifiziert nach  
DIN EN ISO 9001:2000 · Reg.-No. 2184  
DIN EN ISO 14001:1996 · Reg.-No. 2184

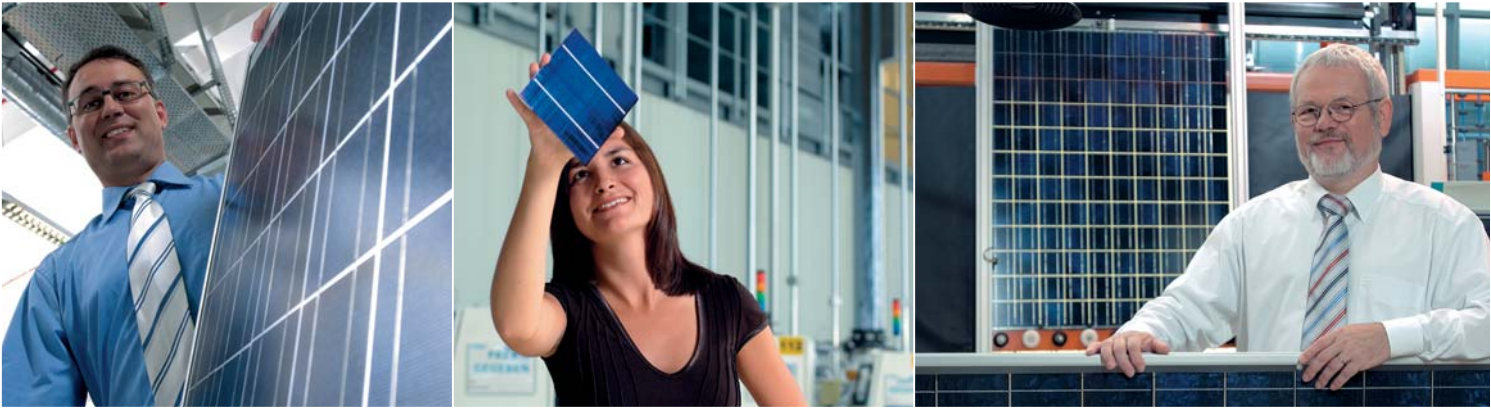
# Convincing in Every Way: Be on the Safe Side with SCHOTT Solar

Choosing modules for solar power systems provides you with a wide choice. There is hardly any difference in the specifications of a lot of manufacturers. Regarding systems which are meant to run in all weathers – and for far more than 20 years - you can only see their real performance after some practical experience. Our products have proven, by operating durably and efficiently all over the world, that they deserve your trust.

## Your advantages at a glance

- ✓ *Experience*
- ✓ *Confidence*
- ✓ *Security*
- ✓ *Quality*
- ✓ *Durability*
- ✓ *Energy yield*
- ✓ *Future technology*





**SCHOTT**  
solar

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