



TECHNOLOGY THAT SETS NEW STANDARDS

GET THE MAXIMUM WITH THE Q-CELLS YIELD SECURITY

So your PV investment pays off quickly and in the long run.



Q.CELLS
YIELD SECURITY

- ✓ ANTI PID TECHNOLOGY (APT)
- ✓ HOT-SPOT PROTECT (HSP)
- ✓ TRACEABLE QUALITY (TRA.Q™)

Q.CELLS
YIELD SECURITY

- ✓ ANTI PID TECHNOLOGY (APT)
- ✓ ADDITIONAL POWER BOOST (APB)
- ✓ 360° EFFICIENCY (TDE)



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Q STANDS FOR QUALITY – PREMIUM SOLAR ENERGY SYSTEMS FOR THE HIGHEST YIELDS

SOLAR CELLS, MODULES AND SYSTEMS FROM Q-CELLS RELIABLY DELIVER CLEAN SOLAR ENERGY OVER THE LONG RUN.

DEAR READERS,

Since its founding, Q-Cells has successfully turned itself into one of the largest photovoltaic companies in the world. The company began as a solar cell manufacturer, then developed into a module producer and system provider. Now, it's on its way to offering integrated photovoltaic solutions. But, the best products and solutions aren't worth a dime if customers don't profit from them. That's why technological innovation, quality and security are decisive criteria for customers – in almost any industry.

In the automotive industry, enormous efforts are made in this regard. Crash test dummies are used to simulate severe accidents, it has to be proved that safety systems function in extremely exceptional circumstances and even seat cushions are put through intense testing. It's always about progress, safety and high quality. After all, quality is what turns a mass product into a first-class, reliable premium product. Why should solar cells, modules and systems be any different? Here, too, quality is essential. It is directly related to our customers' yields.



That's why at Q-Cells technological innovation is a tool for improving and securing yields. Our laser-marked solar cells are protected against counterfeits, the Anti PID Technology prevents power loss in our solar modules and the Additional Power Boost improves the performance of our PV systems. This makes our photovoltaic products durable, efficient, safe and flexible. They generate positive results earlier and in the long-term so that you get a quicker return on your investments.

You're probably wondering what photovoltaics has to do with the automotive industry. Well, the personal mobility of the future is called "E-Mobility". And the energy needed to power it comes from our products – environmentally friendly, decentralized, reliable and, above all, affordable.

Get to know the people in charge at Q-Cells. They make sure that the Q-Cells name is a synonym for the highest quality available – Only quality produces optimal yields.

Dr. Nedim Cen, CEO Q-Cells SE



Convention Center Parking Garage in Frankfurt:
9,261 Q-Cells thin-film modules have been installed on carports and produce 750,000 kWh of energy annually for electromobility.



In 18 months around the world:
The Solar Taxi, equipped with Q-Cells photovoltaic technology, was the first solar-powered vehicle to circumnavigate the Earth.

WOULD YOU BUY A CAR THAT DIDN'T PASS THE CRASH TEST?

Q-CELLS MODULES DON'T JUST HAVE TO PASS STANDARD TESTS – THEY HAVE TO MAKE SOME EXTRA ROUNDS AT THE VDE-TEST COURSE.

Dr. Bengt Jäckel: “Nobody wants to have to replace modules every few years. You should get a good performance for your hard-earned money.”

WHICH TESTS ARE IMPORTANT?

Of course, Q-Cells solar modules have been tested against the current international IEC standards 61215, 61646 and 61730. The test conditions are based on operation in a temperate climate as is common in Central Europe. This ensures long-lasting module function, even when temperatures are high, the humidity rises or a cold snap sets in – and especially under temperature fluctuations. Additionally, the modules are put to truly hard tests according to DIN EN 60068 to ensure their performance under local environmental factors, such as salty sea air, acid rain in the city or ammonia out in the country. But, we put our modules to even harder tests.

WHY DOES Q-CELLS TEST EVEN HARDER?

Q-Cells modules are used around the world, even in tropical climates and desert regions where the climate conditions are extreme. That's why we took the standard tests and, together with the VDE (Association for Electrical, Electronic & Information Technologies), made them even more rigorous. Our modules don't go through the Damp Heat test and the Temperature Cycling test just once, but twice. And they're put through the Humidity Freeze test three times. Q-Cells also participates in the VDE's Quality Tested Program: Our crystal-line modules from our current production are put through endurance tests on a quarterly basis. Because, after all, it's better to be safe than sorry!

WHAT DOES THIS DO FOR YOU?

Our extensive testing program means that you can feel secure knowing that Q-Cells' modules will produce reliable and clean energy generated by sunlight for at least 25 years. This is the prerequisite for secure energy yields so that you don't have to waste time worrying about your investment. Our company and our production sites are also ISO 14001 and ISO 9001 certified and thereby fulfill the international environmental and quality management standards. “Q” stands for tested quality – and you can depend on it.



TEST STANDARDS WELL ABOVE THE NORM

Dr. Bengt Jäckel, Q-Cells' certification expert, works closely every day with renowned testing institutions to improve test standards to make sure that they can really ensure the quality of our solar modules.

“Even in extreme conditions, your Q-Cells modules will provide you with reliable top-notch performances. We can guarantee this because we use the hardest tests on the market.”

TEST ACCORDING TO IEC 61215	CYCLE LENGTH	CYCLE LENGTH AT Q-CELLS	TEST CONDITIONS	BACKGROUND	TEST RESULTS
DAMP HEAT	1,000 Hours	2,000 Hours	Operation at 85 °C air temperature and 85 % humidity	High temperature and humidity lead to quicker module degradation. The reaction of the module to both factors is significant for its long-term reliability.	According to the extended IEC-Tests, Q-Cells modules show: <ul style="list-style-type: none"> • No apparent damage • A maximal degradation of 5 % compared to the initial value. • No change in isolation resistance.
TEMPERATURE CYCLING	200 Hours	400 Hours	Temperature change from -40 °C to +85 °C in <2 hours	Temperature fluctuations put the materials and the entire bonded system under great stress and can lead to severe damages.	The successful completion of extended IEC tests is confirmed on our IEC Certificates.
HUMIDITY FREEZE	10 Cycles	30 Cycles	Temperature change from -40 °C to +85 °C at 85 % humidity in <2 hours	Moist, cold air can lead to frost cracks and very severe damage to the module.	

Overview of the main tests of the IEC 61215 standard as well as Q-Cells' extended testing to ensure long-term stability.

ANTI PID TECHNOLOGY: THE ESP FOR SOLAR MODULES. SO THAT YOUR YIELDS DON'T SWERVE OFF COURSE

TRUST IS GOOD, BUT PREVENTION IS BETTER. FOR SOLAR CELLS AND SOLAR MODULES FROM Q-CELLS, POTENTIAL INDUCED DEGRADATION (PID) DOESN'T EXIST.

Dr. Peter Wawer: "A carefree energy source that's always running at full speed!"

WHAT IS PID?

Based on the way conventional photovoltaic systems work, voltage differences occur between the frames and the solar cells of a module. Especially in wet weather this can lead to undesired leakage currents which can decrease the performance of the cells. According to a report by the industry journal Photon (12/2010), this can result in yield losses of 20% or more. This effect has been named "Potential Induced Degradation", abbreviated "PID".

WHAT DOES PID MEAN IN TERMS OF REAL USE?

Progressive performance losses decrease a system's yield and this often leads to high claim rates for module manufacturers and installers. Plus, proving PID is a very complicated and costly process. Q-Cells prevents PID at the cell level so that modules and entire systems permanently generate reliably high yields.

HOW DOES Q-CELLS PREVENT PID?

The Q-Cells' Anti PID Technology (APT) optimizes the cell production process so that the negative effects of leakage currents are already eliminated at the cell level. This makes both our solar cells and our solar modules PID-resistant¹. In plain English: PV systems from Q-Cells generate reliable energy without any PID-affected performance loss. This means operators and installers can sit back and relax.

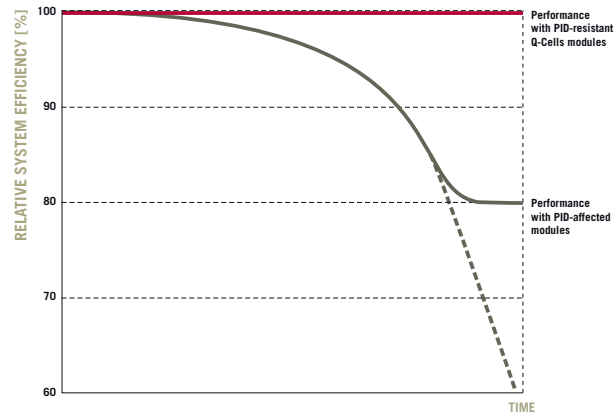
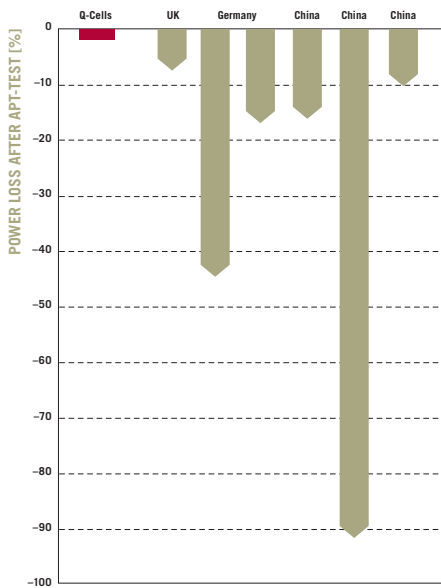
¹ APT-Test Conditions:
Modules at -600 V against frames/supports, module surface wet, 25 °C, 300 h.



YIELDS ARE SAFE WITH ANTI PID

Dr. Peter Wawer, the Head of Technology, has strategically geared research and development at Q-Cells completely toward generating long-lasting top yields.

“We’re tackling the problem at its roots. Each and every cell is of the highest quality and achieves its full performance level.”



Left:

We included eight modules from six market-leading companies in our internal APT test: Six modules from our competitors didn't meet our criteria and showed a performance loss of more than 5% after the test. None of the tested modules achieved the reference value of the Q-Cells modules.

Right:

Potential induced degradation can lead to a performance loss of 20% or more, even in the first few months. Anti PID Technology will save you from this fate.

ON THE ROAD ABS IMPROVES SAFETY. IN THE PV INDUSTRY, ABS IS CALLED HOT-SPOT PROTECT

**Q-CELLS SOLAR CELLS AND MODULES ARE GUARANTEED TO BE HOT-SPOT FREE –
MODULE FIRES ARE OUT OF THE QUESTION.**

**Thomas Raadts: “We keep cool about Hot-Spots. We only send out cells that are
100% Hot-Spot free.”**

HOW ARE HOT-SPOTS CREATED?

During different production steps, the primary material of solar cells – the silicon wafers – are subject to both chemicals and severe heat of up to 900 °C. They are also put under mechanical stress during transport. All of this put together can lead to very small material defects – so-called “micro cracks” – that cannot be seen during conventional final inspections. Defective edge insulation can also cause Hot-Spots.

WHAT CAN HOT-SPOTS CAUSE?

Hot-Spots really pop-up when modules are in partial shade. When one cell in a module is shaded (e.g. by an antenna, chimney or dirt), it doesn't generate any current, but the rest of the cells in the module continue to work. This leads to reverse currents that prefer to run over the Hot-Spot area where they meet less electric resistance. Then, caused by this strong, isolated stress, parts of the Hot-Spot area can heat up to over 250 °C. At this point, the cell can burn through. In the “best case” scenario, this only leads to continual yield loss, but in the worst case scenario the module can catch fire.

WHY ARE THERE NO HOT-SPOTS WITH Q-CELLS?

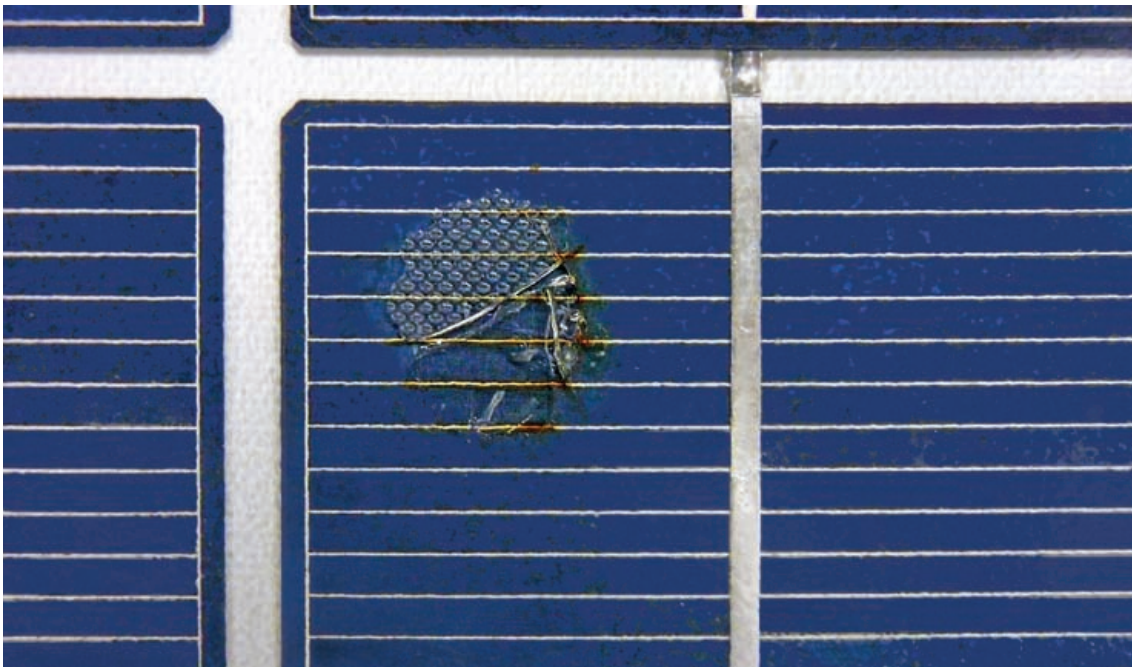
To decrease the risk of Hot-Spots, many manufacturers simply lower the so-called breakdown voltage of the cells. This does reduce the maximum level to which a cell heats up, but it also reduces cell performance. At Q-Cells, however, a reverse current is put through all cells during the final inspection stages. An infra-red camera then shows any Hot-Spot as heat spot. Cells with Hot-Spots are then sorted out and recycled. The result is that our solar cells and modules are Hot-Spot free. With our Hot-Spot Protect, Q-Cells is the only PV company that sorts out all Hot-Spot cells across the board in order to provide system operators with the ultimate level of protection.



PROTECT YOURSELF WITH HOT-SPOT PROTECT

Thomas Raadts, the Head of Marketing and Product Management, and his team make sure that our products can guarantee our customers the highest level of reliability and safety.

“Hot-Spots are not just aggravating because they can lead to performance loss, but also because they can be dangerous for house and home.”



Cells with Hot-Spots can heat up to such a high temperature that parts of a module burn out. In the worst case scenario, a module can catch fire.

THE VEHICLE IDENTIFICATION NUMBER OF YOUR CAR IS ITS FINGERPRINT. **TRA.Q™ IS THE IDENTIFICATION TECHNOLOGY FOR SOLAR CELLS**

**EVERY CELL FROM Q-CELLS HAS ITS OWN UNIQUE CODE.
EVERY CELL IS THUS TRACEABLE AND GUARANTEED TO BE THE REAL THING.**

Daniel Felsch: “You want to know where your solar cell comes from? No problem!”

WHY IS TRACEABILITY IMPORTANT?

When you buy fruit at the market you have the right to know where it was grown. We think this same principle should apply to solar cells and modules. You can feel secure knowing that you have bought a genuine Q-Cells product – and this also makes it possible for us to both keep an eye on and optimize our production processes. Traceable Quality (Tra.Q™) enables us to completely trace the entire manufacturing process for each individual solar cell – this includes the serial number, the date and location of production and even which material charge was used to make the cell. We can thus better analyze errors and even improvements as they arise and integrate them into our development process.

WHY IS PROTECTION AGAINST COUNTERFEITS IMPORTANT?

Solar cells are the heart of any PV facility. There are now hundreds of solar cell manufacturers – including brand-name companies – whose cells are made all over the world, and, unfortunately, product piracy has also hit the photovoltaic industry. How can you know exactly whose heart is actually beating in your module? We know for sure what’s in ours and we can prove it beyond a doubt. Q-Cells solar cells that carry the Tra.Q™ label can be clearly identified. This ensures transparency and means you can count on secure yields thanks to Q-Cells

HOW DOES TRA.Q™ WORK?

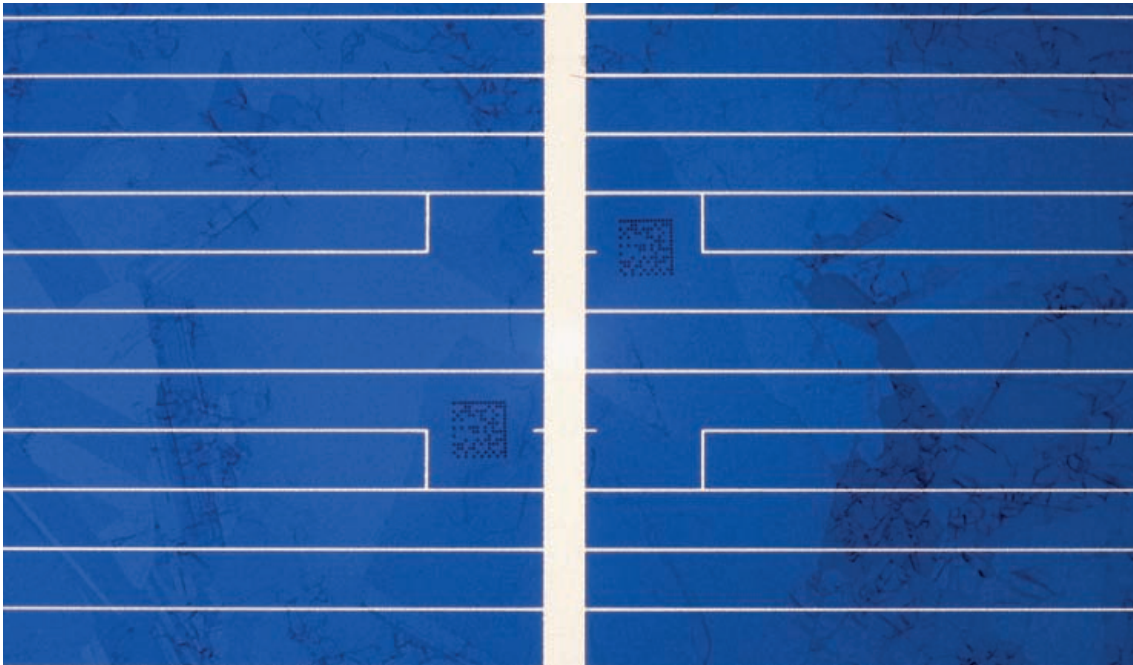
With Tra.Q™ every wafer is labeled with a unique code. Thanks to specially-developed laser technology, the wafer isn’t damaged in this process. The code can then later be read with a special device. Tra.Q™ is like a fingerprint for a solar cell. At the moment, Q-Cells is the only solar cell manufacturer to offer the patented Tra.Q™ labeling technology. And, by the way, we only use cells that we manufacture ourselves for our Q-Cells modules.



TRA.Q™ – THE CERTIFICATE OF ORIGIN

Daniel Felsch, Director of Claims Management, set definitive requirements for Tra.Q™ so that we can guarantee our customers quality cells and quickly answer any inquiries.

“If Q-Cells is on it, then there is Q-Cells quality inside. And that we can guarantee.”



It's small, but it's full of information – The Tra.Q™ code contains information about the place and date of production. This makes it possible to trace certain production conditions for each solar cell.

THE TURBO ENGINE FOR YOUR SOLAR MODULE: THE Q-CELLS ADDITIONAL POWER BOOST

HOLD ON TIGHT! THE ADDITIONAL POWER BOOST CAN INCREASE THE PERFORMANCE OF Q.SMART SOLAR MODULES BY UP TO 15% AFTER INSTALLATION.

Thomas Scholz: “A double power boost for extra yield security – at no additional cost.”

WHAT IS ADDITIONAL POWER BOOST?

It's a power pack for your solar power facility. Additional Power Boost (APB) is our name for the double performance boost that comes with our Q.SMART thin-film modules. Performance booster 1: Q-Cells is one of the few manufacturers that positively sorts its thin-film modules with +5/-0 W. This means that a Q.SMART module with a 75 Wp performance rating has an output of at least 75 W, but it is capable of producing up to 79.99 W – that's an impressive 7% increase in performance. With other manufacturers, you have to contend with outputs that are lower than the rated performance. The second power boost is the Light Soaking Effect that increases the performance of thin-film modules while they're in use.

WHAT IS THE LIGHT SOAKING EFFECT?

Every solar module is affected by incoming light. Normally, this means degradation begins on the first day of use. But Q.SMART modules do the opposite at first – their performance increases. The radiant exposure of CIGS solar cells with light – especially in the short wavelength range – leads to an optimization of cell performance. This is often referred to as “persistent photo-conductivity” which decisively reduces the recombination of electron-hole pairs. In Germany, it takes about 1–2 months to achieve light-saturation of a module. At this point, a Q.SMART module may achieve an increase in performance of up to 8% compared to when it was installed.

WHAT EFFECT DOES APB HAVE ON YOUR YIELDS?

Above all, the Additional Power Boost means one thing for you – More power! When combined, positive sorting and the light soaking effect can lead to an increase of up to 15% over the rated power output. This means you can increase your yield and your income – at no additional cost. In a nutshell, you get more for your money with the Additional Power Boost.



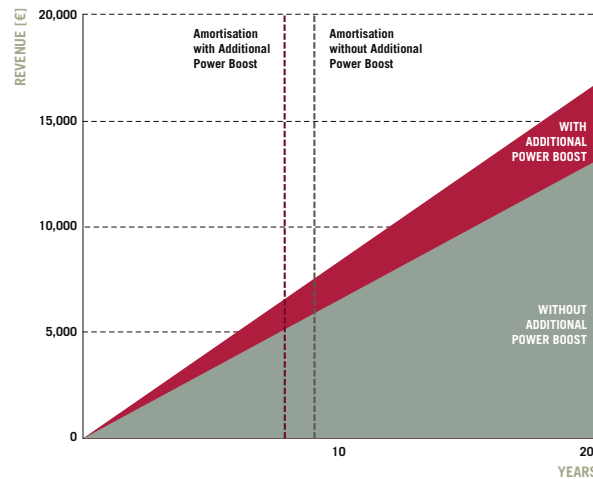
ADDITIONAL POWER BOOST FOR MORE POWER

Thomas Scholz, Product Development Team Leader, is a driving force behind the further development of CIGS thin-film technology.

“My job is not just to make our products better. My job is also about allowing for higher yields for the customer.”



- Nominal power output of a 90 W Q.SMART Module
- Maximum power boost due to positive sorting +5 W/-0 W
- Maximum power boost due to Light Soaking Effect



Left:

The Additional Power Boost can increase performance by up to 15% after module installation. After a good 2 months in use, a 90 W solar module can reach a nominal power output of up to 103.5 Wp.

Right:

The comparison is worth it. With the Additional Power Boost you can increase your income and shorten the payback time dramatically.

WITH Q-CELLS YOU REACH YOUR GOAL EVEN WITHOUT A NAVIGATION SYSTEM. FOR OUR THIN-FILM MODULES, EVERY DIRECTION IS THE RIGHT ONE

THANKS TO THE EXCELLENT DIFFUSE AND LOW LIGHT BEHAVIOR, Q-CELLS THIN-FILM MODULES ACHIEVE OPTIMAL RESULTS EVEN WHEN INSTALLED FLAT.

Thomas Taubert: “Regardless of whether flat or inclined – Q-Cells will get the most out of any location!”

WHAT IS 360° EFFICIENCY?

Does your house not have an ideal south-facing roof? No problem! Our Q.SMART modules have not only been optimized for direct light, but also for diffuse and low light. This means that photovoltaics can be efficiently and productively used at any inclination and in any direction – the complete 360°.

WHAT DOES 360° EFFICIENCY MEAN FOR YOU?

360° Efficiency has finally made it worthwhile to install solar modules in places where everyone used to say you shouldn't: flat roofs, facades and roofs facing north, east and west. Especially on flat roofs, you can use unframed Q.SMART modules without needing expensive and space-consuming inclined mounting systems. This makes it possible to install up to 4 times as many modules and to utilize the entire roof. You can thereby get a full 100% out of photovoltaics.

WHAT EFFECT DOES THIS HAVE ON YOUR YIELDS?

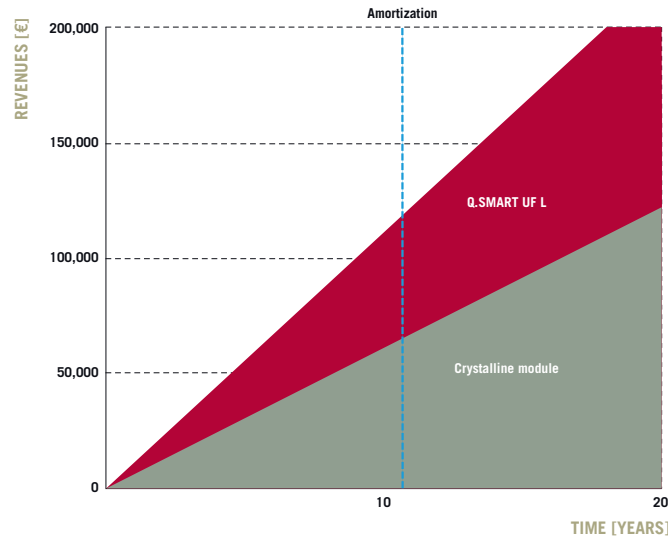
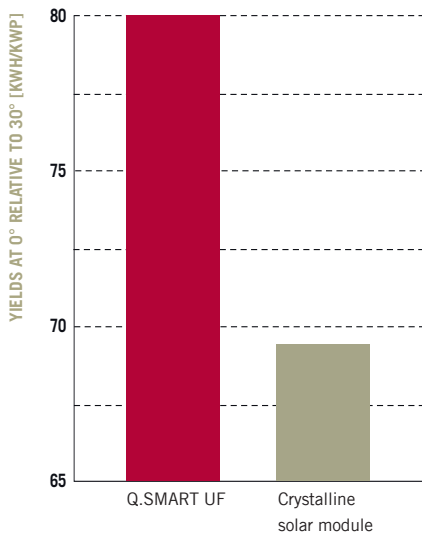
An independent test done in Bavaria compared different solar modules, including both flat and mounted systems, for an entire year. Crystalline modules installed flat generated only 69% of the yields of an inclined system. This meant a yield loss of almost a third. Q.SMART solar modules, however, still generated 80% of the power output compared to the version mounted at 30°. So, even in less than ideal installation conditions, Q.SMART modules still generate worthwhile yields.



360° EFFICIENCY: STRONG EVEN WHEN THE LIGHT IS WEAK.

Thomas Tauber, Product Manager, is responsible for the technical support for the CIGS technology. He knows exactly where to use frameless Q.SMART modules, namely on flat roofs.

“Whether on a garage, bungalow or factory hall – we’ll supply you with the right modules for optimal results wherever you want to harvest solar energy!”



Left: Q.SMART thin-film modules installed at a 0° incline achieve significantly higher relative output than crystalline solar modules.

Right: There are also advantages to roof-parallel installations on flat roofs in terms of surface use. With Q.SMART UF L you can install up to four times as many modules compared to mounted crystalline modules. The yield is thereby almost doubled for the same surface area.

YOUR CONTACT PERSON: WE'RE AT YOUR SERVICE ALL AROUND THE WORLD

LEARN MORE ABOUT HOW YOU CAN GET GOING WITH PHOTOVOLTAICS.

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