



energize
the earth
buy the sun

Recent studies* show: Micromorph thin-film modules are better than crystalline modules under real environmental conditions

When purchasing solar modules, many clients orientate themselves around theoretically determined efficiency levels in order to calculate future energy output. The declared efficiency is based on simulated "Standard Test Conditions" (STC), which are built solely on circumstances in the laboratory. Therefore, these parameters reflect real

environmental conditions only to a limited extent. The average values in reality, that is to say "Most Frequent Conditions" (MFC), lead to a significant change in energy output of the various module types. It is in this way that micromorph thin-film modules from Inventux are substantially more powerful under real conditions than crystalline modules.

* Source: e.g. Solar Energy Materials & Solar Cells 93 (2009), 1062-1065

* Source: Fraunhofer-Institute for Physical Measurement Techniques IPM
** Source: Self test-measurements at the Photovoltaik-Institute Berlin

Laboratory parameters as compared with real environmental conditions

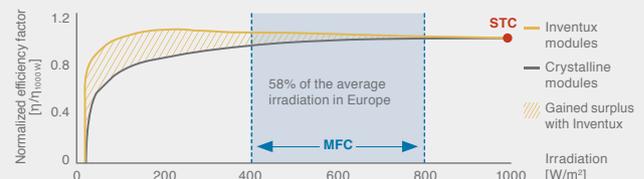
	Standard Test Conditions (STC) ▶ Simulated values	Most Frequent Conditions (MFC) ▶ Real values
1 Solar irradiation	1,000 W/m ² , direct irradiation solely on laboratory parameters (without clouds, smog, etc.)	400-800 W/m ² *, diffuse and direct irradiation incl. environmental influences (with clouds, smog, etc.)
2 Module temperature	25 °C	approx. 40-75 °C**

1 Solar irradiation in Central Europe*



- Only approx. 40% direct solar irradiation per year
- Diffuse light predominates in Central Europe with about 60%
- ❗ **Problem:** The STC-simulation is solely based on direct solar irradiation at 1,000 W/m²

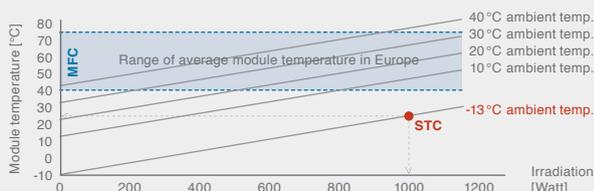
Low light characteristics Inventux modules**



- Inventux modules offer high returns with diffuse light
- Crystalline modules deliver reduced performance
- + **Inventux Plus:** Optimal energy output even with irradiation under 800 Watts (European conditions during 80% of the year)

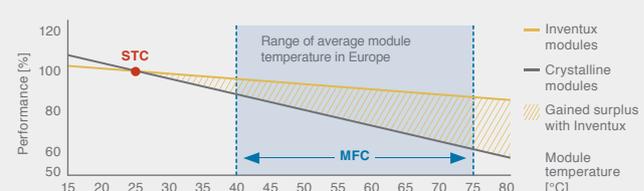
* Source: Planning and Installing Photovoltaic Systems, DGS 2008
** Source: Solar Engineering GmbH, OC Oerlikon and self test-measurements

2 Module temperature in Central Europe*



- All module types show module temperatures that are significantly higher than the ambient temperature
- ❗ **Problem:** In order to reach the STC-simulation module temperature of 25 °C at 1,000 W/m² irradiation, the ambient temperature needs to be at -13 °C

Temperature coefficients Inventux modules**



- Inventux modules maintain the majority of their excellent performance even with increasing module temperature
- The performance of most other modules drops significantly
- + **Inventux Plus:** Increasing energy yield and returns with higher temperature when compared to crystalline modules

* Source: Calculation performed using ISEH Harnel/Emmental model
** Source: Test-measurements at the Photovoltaik-Institute Berlin

Inventux modules are profit-stars with returns higher than 8 % compared to crystalline modules*

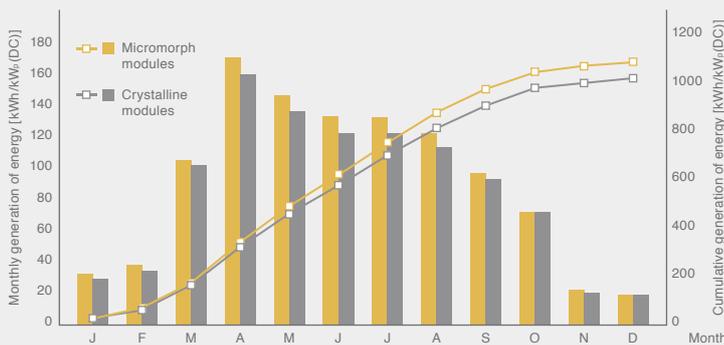
Inventux modules are today's high yield alternative for tomorrow. Through our micromorph thin-film technology Inventux modules offer a higher energy production under real conditions, in other words: "Most Frequent Conditions" (MFC), and with that automatically higher returns than, for instance, conventional

crystalline solar modules. Inventux modules – an investment that pays off in reality and not just under simulated laboratory conditions.

profitable. sustainable. micromorph

* In the demonstrated returns calculation under the given parameters

Profitability by comparison*



The measurement shows that micromorph photovoltaic modules generate substantially higher yields due to their technological properties. Compared to conventional crystalline modules, the micromorph thin-film technology can even reach a higher energy efficiency in Germany of about 7-10 percent per year. In other words: With a 1 kW_p system, up to 100 kWh more energy is gained annually.

Generation of energy comparison (monthly and cumulated) January - December 2007, Germany

* Source: Institute for Solar Energy Supply Technology (ISET), modules MHI

Demonstrated returns calculation

	Inventux modules	Crystalline modules
Installation performance	10 kW _p	
Equity return	22.79 %	13.98 %
Return gains with Inventux modules	Nominal: + 8.81 % p.a.	
Premises	20 % equity, credit period 18 years – 1 year free of redemption, interest rate 5 %, location Berlin, same system price for both installations, irradiation 1,008 kWh/m ² a, based on German feed-in tariff at 39,14 ct	

Would you like to find out more about the profitability and sustainability of our micromorph Inventux modules? We are gladly available to you for a consultation at no obligation.

