The "Energielabor" at the University of Oldenburg can be seen as symbolic of Oldenburg's energy research. It was planned back in the 1970s, when the oil crisis triggered a search for new forms of energy. Rather than expanding the use of nuclear power the Oldenburg scientists set their sights on harnessing the wind and sun as energy sources. The research group "Physics of Renewable Energies" set out to prove that it was possible to run a laboratory powered entirely by renewable energy sources. In 1982 it became the first building to go into operation on the University's Wechloy campus. Until the early 1990s, the "Energielabor" was the subject of almost all research in the field of renewable energies in Oldenburg. Today the building is used for practical training, lectures and office space. In a few months' time the "Energielabor" will celebrate its 30th anniversary, but some of its installations have been operating for considerably longer. A number of the photovoltaic panels there have been in use for 36 years – a record time in Germany. The solar panels were manufactured by the firm AEG-Telefunken under the product name "TSG MQ 36/0". At the time the electricity company's headquarters were located in Wedel, near Hamburg. Over the years the company changed names several times, passed into the hands of Daimler-Benz and RWE and now forms part of the technology group Schott AG and is called Schott Solar GmbH. Before the 336 modules with a total rated output of 3.5 kilowatts were installed at the "Energielabor" in 1981 they had already been operating for five years as part of a project funded by the Federal Ministry of Education and Research. Today, the modules at the "Energielabor" constitute the oldest photovoltaic array of such size in Germany. The "Energielabor" therefore offers ideal conditions for observing the lifetime of solar cells. Because there are hardly any other installations of this size and age in Germany, there is a lack of information about the economic efficiency of photovoltaic arrays. They are generally assumed to have an average lifespan of 25 years. Almost all economic efficiency calculations used for planning the financing of photovoltaic systems are based on this figure. If a photovoltaic array falls short of the operating life guaranteed by the manufacturer the operator of the system faces considerable financial and economic problems. The solar panels at the Oldenburg "Energielabor" have already exceeded the expected operating life by more than ten years. And they still provide operating data that on the basis of precise measurements testify to unaltered quality regarding electricity production.

The oldest photovoltaic array still in operation.

But what can limit the lifespan of photovoltaic arrays? There are essentially two factors. On the one hand the characteristics of the semiconductor materials can alter while the system is in operation. This process is referred to as degradation. The degradation process depends on the materials that are used. For the production of the solar cells at the "Energielabor" silicon was used: a classic semiconductor metal that is extremely durable and barely changes its characteristics over time. On the other hand – and this is the main factor limiting their lifespan – solar cells need to be protected against environmental influences and connected to the electric system. This entails the use of components such as glass coverings, frames and cable connections which can corrode or crack and therefore constitute the main weak points in a photovoltaic array.

Photovoltaik-Modul AEG-Telefunken TSG MQ 36/0
(temperature 25°C)

	1976	2011
rated power	10,3 W	9,9 W
open circuit voltage	21,0 V	20,3 V
short circuit voltage	685 mA	664 mA
MPP-voltage	16,6 V	16,6 V
MPP-current	630 mA	607 mA
efficiency	8,55 %	8,2 %
total number of mudules		336
total power		3460 W

Hardly any variations after 35 years in operation: the manufacturer's specifications in comparison to the Oldenburg measurement data.

The quality of a photovoltaic array that has been in operation for some time can be measured in several ways. At first there is the visual inspection, which reveals external signs of aging. Frequent problems are corrosion and bleaching of the cells, the so-called "browning" phenomenon in which the plastic material encapsulating the cells becomes discoloured as a result of UV radiation. Solar panels can also be damaged as a result of bubbles forming in the plastic encasements or degradation of the plastic, as well as cracks in the glass and corroded cables. But only careful measurements carried out in the laboratory can provide detailed information about the true state of a module. The solar panels are examined under conditions that are precisely defined e.g. as regards amount and spectral distribution of irradiance on the module level, as well as cell temperature. Continuous measurements assessing the total output of the array at the "Energielabor" had indicated that it still had a very good operating performance when compared with the manufacturer's specifications. In 2010, the researchers of the "Energy and Semiconductor Research Laboratory" decided to investigate further, and in November they detached individual modules and measured their performance in the laboratory.

Photovoltaics: "An energy source with huge potential."

The results were astounding: providing for the usual deviations from the manufacturer's specifications, which are aimed at a hardly realistic ideal operating performance, after 35 years in operation the modules still displayed only minimal alterations regarding the key parameters. Both the short-circuit current and the open-circuit voltage were just three percent below the original values, while the fill factor was actually two percent above it. The efficiency, ultimately the decisive factor, was four percent below the values specified by the manufacturer.