



Breaking the cycles of waste

The rush into the photovoltaic market has seen some companies rush in order to have working equipment for production and may not be aware of further cost saving potential within their tools and processes. **RUV Systems** discusses the results of a recent study.

Although photovoltaics have been with us for a number of years it is only relatively recently that the industry began to manufacture at the present scale and volume. In the rush to take advantage of a growing market, manufacturers needed to establish infrastructure that would lead to product and revenue generation.

This rush to manufacture has meant that all available yield management tools and processes were not necessarily employed in the initial setting up. This does not mean these manufacturers cut corners to produce inferior product. What it does mean is that many manufacturers have hidden improvements waiting to be revealed in their current manufacturing process flow.

It seems like a simple process. Checking the quality of incoming wafers and cells before they go into the production process. It even seems like a logical step in manufacturing but it may surprise you to know that it is still not common in the photovoltaic cell and module manufacturing market.

An area that is surprisingly lax is cracks in the device or cell, also referred to as micro cracks, that potentially cause wafer and cell breakage during the production process and have a negative quality effect on the entire process. Other industries, such as semiconductor, have shown the benefit of this type of proactive yield management. Despite the constant search for incremental savings, it is an area that has still not been explored to its full capacity.

Some steps have been made here and there but this generally depends on the individual company and the background knowledge of the staff on site. Recent research in The Netherlands suggests there is still huge savings opportunities for companies that could help them reach a grid parity target quicker than imagined.

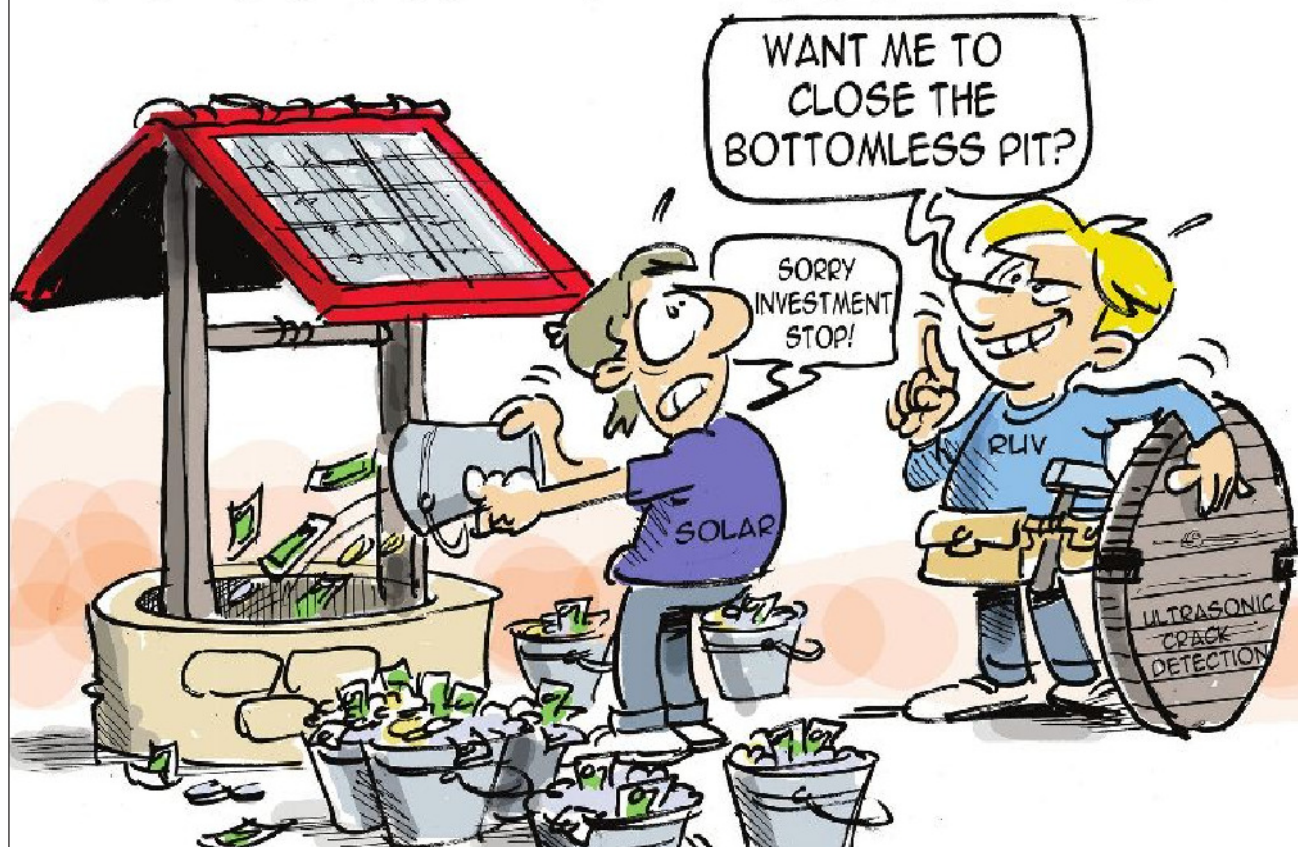
Ultrasonic Technologies Inc. (US) and RUV Systems BV (Netherlands) did extensive research on the issue of the impact of cracking on subsequent manufacturing. This work was done in cooperation with cell and module manufacturers across Europe and Asia. Ultrasonic resonance vibrations (RUV) technology was used to test

wafers and cells on cracks and their effects on breakage during production. The goal was to determine what part of breakage during production is caused by process equipment and what part by the quality of incoming products.

RUV technology is used to measure residual stress non destructively in full size multicrystalline silicon wafers used in solar cell manufacturing. RUV works by exciting the longitudinal resonance ultrasonic vibrations in the test material by using an external piezoelectric transducer. This is combined with an ultrasonic probe and data acquisition of the response makes it suitable for in-line diagnostics during wafer and cell manufacturing.



WASTING MONEY IN THE SOLAR FACTORY



The results of the research were striking. What was most telling was the confirmation that, in general, the majority of breakages in cell and wafer manufacturing was caused by cracks already present on incoming wafers or cells. A simple proactive approach of rejecting damaged wafers and cells as they are discovered saw the breakage rates in production decrease by 21% and up to an extraordinary 88% reduction in breakages.

This difference in the figures depends on the type of manufacturing, the level of manipulation to the silicon during production and the thickness of the wafers being used. The results of the study showed that any other breakage that occurred was caused by the process equipment during the manufacturing process.

The results of the study suggests that a great deal of cash is being wasted in photovoltaic factories every day. Money is invested into wafers and cells that will not make it to the end of the production line. For example in a cell manufacturing line with a capacity of 1.800 cells/hr, this leads to a loss of 500k up to more than 2 million euros each year.

This sort of wastage would appear to be a very expensive money pit for manufacturers. The results in this study did not include losses due to quality problems caused by cracks that showed up at a later stage such as claims on reduction of module capacity. The focus here is on what manufacturers can do to improve their current situations.

Although tuning of process equipment can and will improve yield in general, the real need currently for process improvement should be on incoming and outgoing inspection of wafers and cells. Investing in process improvement at this moment in time is limited due to the current financial situation that the world continues to face.

However, the financial reasons for such resource investment is fairly obvious. Nipping the cracks in the bud will save money down the line. The process improvement research discussed here was done with ultrasonic analysis based on the frequency response curve of the crystalline material. This is a more reliable method than optical inspection and is a non invasive process that will ensure you have no cracks in your silicon.