Backsheet or bust?
The true cost of broken backsheets in the solar industry

Across the solar industry, backsheets can deliver outstanding benefits, both for performance and solar projects’ net present value (NPV) – but only when they work well. In fact, backsheet failure is all too common: in 2020, $260 million CAPEX is expected to be lost due to early backsheet failures. Materials supplier DSM has developed a high-quality solution to mitigate this issue – a polyolefin-core, co-extruded Endurance backsheet that can drive the long-term viability of solar modules. PES meets with Vivek Chaturvedi, new business lead for DSM’s Endurance backsheets, to discuss how this backsheet works and how DSM hopes to further penetrate the market.
**PES:** Welcome back to PES. Could you briefly introduce DSM again and the role it plays in the solar industry?

**Vivek Chaturvedi:** DSM is a global science-based company in health, nutrition, and sustainable living. Our mission is to create brighter lives for all, with a particular focus on addressing the UN’s Sustainable Development Goals (SDGs). In particular, we have more than 50 years’ experience in materials science, over a broad range of industries. DSM Advanced Solar develops material technologies that boost the power generated by solar photovoltaic (PV) systems and reduce the cost of solar energy.

With more than one billion people in the world still without access to electricity, our mission in solar is to make affordable solar energy available for all. Within this mission, we aim to address three SDGs in particular: #7 (access to affordable, clean energy); #12 (responsible consumption and production); and #13 (taking urgent action to combat climate change). We do this by developing sustainable material technologies that lower the cost of solar energy, supported by R&D facilities in Europe, China, the USA, India, and Japan. Increasingly, we are focused on solar backsheets.

**PES:** In your opinion, what were the biggest changes in the solar market last year?

**VC:** The solar market is experiencing dramatic change and new developments are driving cost of solar power down to newer levels, making it more affordable and relevant for new geographies. One big change in 2019 was the rise of bifacial modules, which allow light to reach the cells from both sides. This technology has been around for a while but its adoption picked up last year, driven by improvements in cell technology. Another significant change was the widespread increase in system voltage from 1,000 to 1,500 volts, which we think will become the standard utility segment system voltage in 2020. Finally, the Chinese solar market’s growth slowed down last year – the global solar market’s 10% growth this year was driven by other regions. In particular, we saw greater growth from regions of the world with harsher climate conditions.

**PES:** You are responsible for the backsheet business within DSM. Can you give a short description of the backsheet market and how it is likely to develop in the near future?

**VC:** Despite the rise of bifacial solar modules, the backsheet market is growing healthily. However, it saw around a 40% selling price reduction in the last 18 months, as increased demand for low-cost solar modules put every component under extreme price pressure. This has forced many mainstream players to make changes, such as reducing the protective layer’s thickness and compromising on material choices across all the layers and adhesives. This makes backsheets a very different product from what they used to be, despite having the same old structures and certificates, and increases the risks to PV plant performance and hence returns.

Other solar market trends will also affect the backsheet market in the near future. Bifacial modules present an opportunity for the industry – that of developing transparent backsheets – and the doubled surface area will drive demand for our coatings. Increased system voltage will also require more robust backsheets.

**PES:** How relevant are backsheets and material choices when designing new solar modules?

**VC:** Backsheets are very important indeed – as the outermost layer on a PV module, the backsheet is the first barrier against the outside world. However, until recently this importance was widely underestimated. It’s common for manufacturers facing increased cost pressure to exchange parts of the bill of materials for cheaper or more readily available materials as a quick solution. In fact, neglecting backsheet quality can seriously damage the long-term cost-effectiveness and success of solar projects. In 2020, $260 million CAPEX loss is expected worldwide because of early backsheet failure – and this is just for panel replacement. To avoid these losses, manufacturers and developers should use credible global partners as backsheet suppliers.

**PES:** Do you think module manufacturers and developers have enough know-how to make good choices on backsheet materials?

**VC:** Most ‘Tier 1’ module manufacturers and developers are aware of the issues around backsheet quality; however, many new players may still be misinformed about the best solutions. Lack of transparency on industry practices is a big problem – for example, current rules do not require re-certification of backsheets when new adhesives are introduced.
What’s more, current International Electrotechnical Commission (IEC) tests are designed only to find obvious early field failures, rather than durability over a module’s entire lifetime. A backsheet that has passed the IEC test may still fail when exposed to real-life solar park conditions. However, there are signs of improvement – for example, the IEC has recently decided to release global standards for backsheets.

PES: Let’s take a more detailed look at your own product, the Endurance backsheet. Can you give a short description of the product itself and its properties?

VC: Sure! Endurance backsheets are co-extruded with a strong, non-PET polyolefin core – the strongest on the market. Polyolefins (PO) are better suited to long-term outdoor protection than traditional PET cores, which are sensitive to moisture. We’ve found that PO delivers exceptional moisture resistance, electrical insulation, and protection against mechanical abrasion and UV, which is particularly useful for desert and floating PV projects. In fact, for moderate climates, our PO core doesn’t even need an external protective layer. For modules that need to operate in extreme weather conditions – we use polyamide 12 as an extra, weather-exposed layer.

The co-extrusion process used to make these backsheets is one we’ve used for years in several materials science applications, and we believe it will become an industry standard. Because it’s a single-step process that doesn’t require adhesives, it delivers an excellent cost-performance ratio and minimizes the risk of delamination. Not only does co-extrusion drive quality, it also enables much-needed transparency and traceability in the backsheet supply chain. Whereas traditional laminated-backsheet suppliers must source pre-manufactured base films, we always know which materials are used, how much is used, and how they are processed.

PES: DSM backsheets do not contain fluorine, which is often regarded as the golden standard. Why did you decide not to use fluorine, and does it impact the backsheets’ performance?

VC: It doesn’t – in fact, some tests show our fluorine-free backsheets performing better than traditional equivalents. Our decision not to use fluorine ultimately comes down to our core mission. To develop truly sustainable solutions, we need non-toxic materials with lower carbon footprints. Our backsheets’ carbon footprint is up to 30% lower than fluorine-based laminated equivalents. What’s more, they are 100% recyclable with no production waste, and their end-of-life treatment cost is low.

PES: For project developers and investors, it’s all about reliable performance and solid returns on investments. Should backsheets play a role in their assessment of the bill of materials?
VC: Absolutely. As mentioned earlier, early backsheet failure is expected to result in $260 million CAPEX loss this year – backsheet quality can hugely impact a project’s success. What’s more, it can also affect the project’s financial model, allowing more generous assumptions about lifetime. For example, using Endurance backsheets can increase a project’s NPV and IRR by reducing power loss and increasing useful life, compared with PET-core backsheets.

We now have a proven track record of this impact. We’ve now applied over four gigawatts (GW) of Endurance backsheets in solar parks worldwide. Six years of performance data shows no failures.

A report from Black & Veatch concluded that they are more durable in a desert environment, showed less decrease in tensile strength after UV exposure and other aging tests, and have a superior moisture barrier.

PES: Can you give an example of how project developers can benefit from DSM’s backsheet?

VC: High-quality backsheets produce modules with longer expected useful lifetimes. Assuming an average useful life of 30 years for projects built today, and given that the prevalence of backsheet issues is around 9%, a project with no backsheet issues is expected to last approximately three years longer than the same project with an average backsheet. Incorporating this assumption into the financial model will increase the project’s NPV, providing a measurable benefit for developers.

PES: Are there any new backsheet products in your pipeline, and if so, can you already touch upon these?

VC: Yes – we’re expecting to add new products to our Endurance backsheet portfolio for mainstream application soon.

PES: What other products does DSM offer to solar customers and do you see synergies?

VC: We also offer anti-soiling and anti-reflective coatings, and conductive backsheets. There are certainly standard synergies in sales, technical support, and market intelligence for these products. However, I also think synergies with other DSM business groups are very relevant: our expertise in materials and material technologies – such as packaging and extrusion – play a big role in these efforts too.

PES: And what about the future? Does the future look bright for DSM regarding solar energy?

VC: We believe the era of solar innovation is only just beginning – and we cannot realize its success alone. As we develop our backsheet and wider solar technologies, we’ll continue to work with industry partners to build a rock-solid business case for backsheets that perform better, last longer, and deliver superior value.

For example, over the next three years DuraMAT (Durable Module Materials Consortium), one of the world’s leading independent evaluators of solar technology, will test our Endurance backsheets – as part of DSM’s largest-ever solar research project.

This will help us demonstrate the DSM backsheet family’s superiority, but it will also help us create the next generation of high-performance products. The future looks bright indeed!

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ASK THE EXPERTS: COMPONENTS

Are polyamides bad?

DSM uses polyamide 12 as a high-performance protective layer in some of its Endurance backsheets. For years, this has been the material of choice for the automotive, aviation, and energy industries, thanks to its proven physical, chemical, and mechanical reliability in harsh environments.

But within the solar industry, misconceptions about polyamides are common. This is partly due to the 2010 failure of modules incorporating polyamide-core AAA backsheets filled with glass fiber. The solar industry is still paying the price of this failure – and although it was caused not by the use of polyamide but by the poor design and low quality of the glass fiber, some players have used it to tarnish the reputation of polyamide materials.

In fact, if used properly, polyamides are excellent materials for PV. Their exceptional resistance to UV, abrasion, and moisture makes them ideal for protecting modules in desert and tropical climates – it’s thanks to polyamide that our Endurance backsheet was awarded the 2018 TÜV Rheinland award for ‘best desert application’.

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