

# Enhancing organic solar cells' green glow

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Eucalyptus leaves. Credit: [Donald Hobern](#) from Canberra, Australia/Wikimedia Commons, [CC BY](#)

Organic solar cells could be made even greener by switching the solvents used in their manufacture. Today's toxic chlorinated solvents can be

replaced by plant-derived alternatives without affecting the resulting solar cells' light-capturing performance, KAUST researchers have shown.

Organic photovoltaics (OPVs) are one of the greenest solar cell technologies, contributing as little as three grams of CO<sub>2</sub> equivalent carbon emissions per KW of energy. "However, their [fabrication](#) still relies on halogenated solvents that, on top of being linked to reproductive hazards and cancer, are derived from petrochemical processes," says Daniel Corzo, a Ph.D. student in Derya Baran's lab, who led the work.

"We wanted to find green alternatives to protect the health and safety of workers when these cells are manufactured at a larger scale and to further reduce the carbon footprint of OPVs."

Solvents are critical to OPV manufacture as they are the basis of the printable inks that [organic solar cells](#) are made from. "These inks require the organic active materials to remain in solution during processing and then crystallize under optimized conditions as the ink dries," Corzo says. "Solvent choice greatly affects OPV processing and overall device performance."

The team identified potential alternative solvents by applying a framework called the Hansen solubility formulation. "This methodology measures how similar molecules are to one another based on their molecular interactions," Corzo explains. "You can select solvents that are alike at the [molecular level](#) but have beneficial properties, including reduced toxicity, or that originate from renewable sources."

The technique revealed that plant-based solvents called terpenes—a group that includes the aromatic oils eucalyptol and limonene—could be suitable replacements. "These solvents can be derived from plant

residue, such as eucalyptus leaves or orange peel, or be produced from algae and microorganisms in bioreactors," Corzo says.

Solvent blends based on these substances proved to be an excellent fit for OPV manufacture. "We obtained [solar cells](#) with efficiencies above 16% using terpene-based inks—essentially the same as from chlorinated solvents—but with an 85% lower carbon footprint and with the potential to become carbon negative in the future," Corzo says.

"We believe that multiple industries and tech developers will benefit from terpene [solvent](#) development," Baran adds. The team has made their findings freely available in an interactive [online library](#) for green solvent selection. "This library can go beyond the use of green solvents for organic electronics because terpenes are also used in food and fragrance industries, for instance," she notes.

The findings are published in the journal *Nature Energy*.

**More information:** Derya Baran, High-performing organic electronics using terpene green solvents from renewable feedstocks, *Nature Energy* (2022). [DOI: 10.1038/s41560-022-01167-7](https://doi.org/10.1038/s41560-022-01167-7).  
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