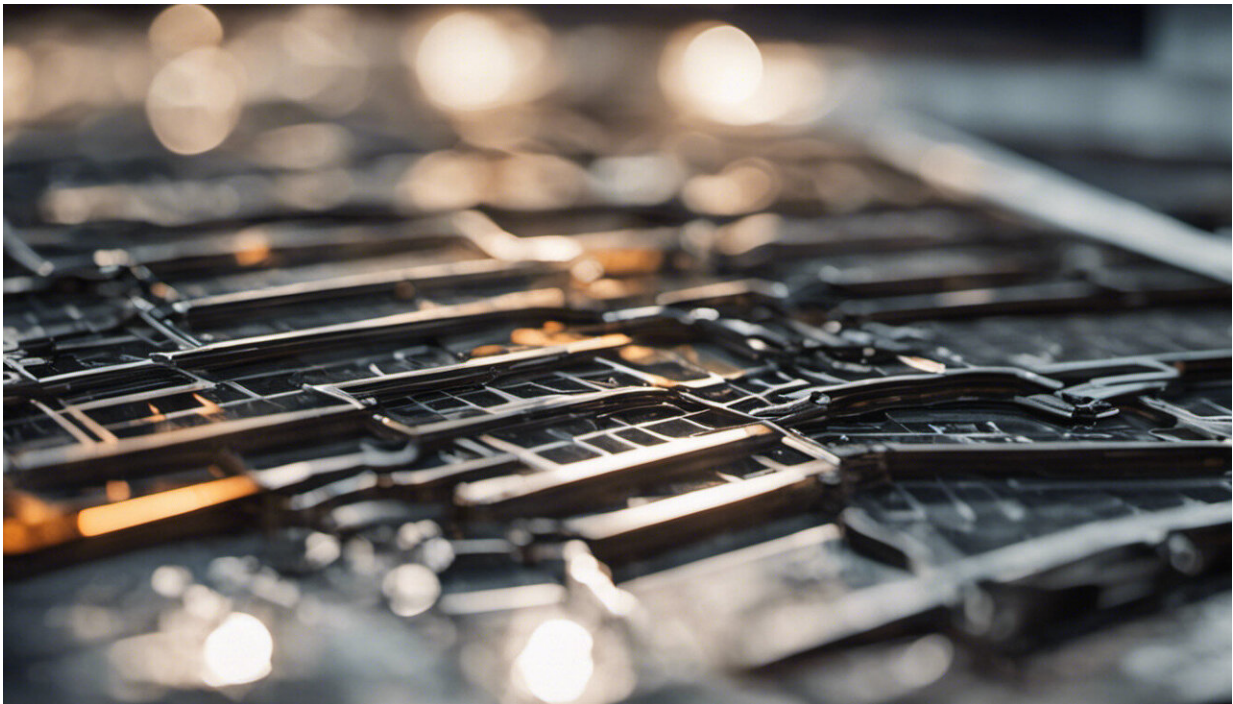


Repair, reuse and recycle: Dealing with solar panels at the end of their useful life

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Credit: AI-generated image ([disclaimer](#))

UNSW Sydney solar experts say we need bespoke technology designed to recycle important elements inside solar panels.

In Australia, [solar power](#) is one of the country's leading renewable energy sources with rooftop solar PV installed in more than 3.3 million

homes.

Sadly, approximately 90% of these systems might ultimately end up in landfill once they need to be replaced.

A 2016 report by the International Energy Agency estimates Australia will generate 145,000 tons of waste from PV panels by 2030.

UNSW solar expert, Dr. Richard Corkish from the Australian Center for Advanced Photovoltaics, based at UNSW Sydney's School of Photovoltaics and Renewable Energy Engineering, says the sustainability principles of "Reduce, Reuse and Recycle" should be applied to the end-of-life management of all PV modules.

"We've seen a huge uptake in both small-scale and large-scale PV deployment in the last decade as the world moves towards [renewable energy sources](#)," he says.

"The industry standard for most [solar panels](#)' lifespan is 25 to 30 years which means solar systems installed more than 15 years ago will soon be approaching their end-of-life.

"Additionally, in the last decade, we're seeing a growing trend of replacing PV modules even though they are in perfect working condition. A lot of people installed small expensive systems some years ago but rather than adding on to them, they've been convinced to replace them altogether.

"From a manufacturing point of view, the photovoltaics research community is trying to lengthen the life of the modules by making them more resilient to the environment, particularly moisture and oxygen.

"The goal is to extend the life, so they last up to 50 years which means

we won't need to make nearly as many in the future. If we suddenly need to ramp manufacturing, we'll find there are some materials, including silver and aluminum, that will be at risk of being in low supply."

Avoiding landfill

Up to 95% of the materials used to make a solar panel can be recycled, with the most valuable parts being the silicon, aluminum frames, and silver—which is mainly used in the front contacts of the module.

For panels that are recycled, the most common process in Australia results in the panels being put through a standardized shredding machine where they are broken into smaller pieces. These pieces are then down-cycled into other products such as an additive in the production of construction bricks concrete or even roadbase.

Dr. Rong Deng, Research Fellow from the UNSW School of Photovoltaics and Renewable Energy Engineering, says the biggest problem with the current process is the inability to extract the rare metals in the panels while keeping costs down.

"To be reused, solar panels components need to be carefully separated to avoid contamination with other materials. Manufacturers will only reuse materials that have a high purity—which is difficult to achieve," says Dr. Deng, who was named in the 2022 Forbes 30 under 30 Healthcare and Science List.

"The current process is a temporary solution. It's great if all panels are recycled because we want to avoid it ending up in landfill. But if we think ahead, the materials we're using right now are not always going to be readily available later.

"The silver embedded inside the cells is highly sought-after because of

its value in pure form. However, the challenge we face is how we do that cheaply and without adding to our carbon footprint.

"But if continue down the path of using non-specialized technology to recycle PV modules, then we'll still continue to end up with parts that are contaminated with other materials which is not a sustainable solution."

Cost of disposal

The management and disposal of PV modules varies between each state and territory. In Australia, only Victoria have officially banned solar panels from ending up in landfill, meaning they need to be taken to e-waste drop off points to be recycled. Under a new proposed recycling expansion program, Queenslanders will soon be banned from dumping solar panels in landfill in the next decade.

However, consumers and businesses can expect to pay between \$10 to \$20 per panel to recycle, plus any freight or removal fees. In states that do not have a policy on recycling solar panels, this extra cost could be a massive deterrent to recycling and more of a reason to dispose of them in a landfill facility, says Dr. Deng.

"If you have a system of 10 panels on your roof, you're going to pay at least \$200 to dispose of them," she says.

"The Australian Government have signaled potentially adding PV modules to the Product Stewardship Scheme. Similar schemes are already in place for other goods such as car tires and plastic bottles."

A Product Steward Scheme is an approach which involves taking responsibility for the full life cycle of a product. It promotes and supports the principles of circular economy and schemes can be voluntary, made mandatory by Government or done in partnership with

industry.

Dr. Corkish says if everyone who imports, designs, produces, sells, and uses PV modules has a shared responsibility for reducing the environmental impact—then it would further incentivise manufacturers to invest in better PV recycling technology.

"There needs to be a system in place where costs are recouped from the industry so that cost imposed on new modules can pay for the recycling of the old ones," says Dr. Corkish, Chief Operating Officer of the Australian Center for Advanced Photovoltaics.

"However, the caveat is in the long service life of PV modules. Because they last up to 30 years, the companies who are currently active in the market were not necessarily the ones manufacturing the older panels on rooftops today.

"But the bottom line is that end-of-life PV systems will be a future environmental problem unless we address it now."

Better and cheaper testing

For newer models of PV systems, homeowners can track and compare energy output through an online system or mobile app. However, Dr. Corkish says some homes are prematurely upgrading their solar systems well before they need to.

"While there's huge potential for reuse of PV modules, the lack of affordable testing to ensure the panels still meet electrical safety standards means many make their way to landfill," he says.

"Sometimes the backsheets are the first thing to go but they can sometimes be repaired or replaced. If the diodes fail, they can be

replaced too.

"Sometimes panels still haven't reached their full life yet and we don't want that to go to waste."

Is the future of PV recycling looking bright?

Australia is no stranger to the solar PV system. UNSW Engineering's Professor Martin Green is a world-renowned expert, leading the development of market-dominating PERC technology which has improved the quality of both the top and the rear surface of standard silicon solar cells.

Dr. Deng recognizes that recycling of PV modules in Australia is still in its infancy with only a handful of recycling facilities available in the country. She says there's a lot to learn from countries in Europe who are far ahead in terms of addressing the problem.

Early adopters of small-scale rooftop PV systems, such as Germany and Netherlands, have been acting with much more urgency in terms of finding viable technologies to recycle older PV panels, which are coming up to their end-of-life phase.

"Countries in Europe have built the prototypes for separation technologies and have several pilot lines to test the feasibility. But most importantly, they have the motivation to do it," she says.

"In Australia, we're still waiting for the waste bomb that is predicted when all these PV modules come to the end-of-life, so there's less incentive for local companies to invest in the technology.

"At some point, there will not be enough landfill to dispose of PV modules—nor will there be enough resources to build them. So, it's

imperative we find a sustainable solution to recycle them now."

Provided by University of New South Wales

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