

On solar panels: our latest mountain of waste

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It is often the case with environmental problems that they are ignored until they are overwhelming us. And so it goes with solar panels, which will emerge as the pre-eminent waste issue *du jour* when the first generation of PV panels installed in the early 2000s reaches the end of its useful life around 2030.

Unlike wind turbines, which are made of homogenous and relatively easy to recycle materials, solar panels are a complex, multilayered fusion of glass, silicon and minerals such as silver and copper. The International Energy Agency predicted in a 2016 report that Australia will generate 145,000 tonnes of PV panel waste by 2030, although this figure is now almost certainly higher given the exponential popularity of utility scale solar installations since then.

Put in a more visually appealing way, if the disused solar panels were stacked on top of each other, they would look like 241 Mount Everests. And that's just the waste coming from Australia, which makes up only a fraction of the global solar market.

Predictably, very little has been done to foster a circular PV panel economy until recently because the 2030 crunch point seemed so far away. But experts say Australia has a lot of catching up to do before it will have the capacity to adequately recover the contents of the PV panels that will need to be recycled in coming years.

What's being done about it?

There have been encouraging signs from state and federal governments. New South Wales last year handed out \$10 million in grants from the Circular Solar program to spur investment in recycling technologies, and the federal government is gradually developing a product stewardship scheme with industry partners that will include R&D and funds to support a domestic PV recycling industry.

One of the Circular Solar grant recipients PV Industries is at the forefront of the recycling movement with its novel way of dissecting PV panels into their various layers. The process separates the glass and the aluminium frame from the solar cells and recovers around 90 per cent of a panel's contents.

But the technique is far from perfect – extracting the silicon and the minerals from the solar cells cannot be achieved via mechanical methods alone – either thermal or chemical methods are needed. There is not enough silver to meet the demand from millions of solar panels that will need to be installed in coming years, so finding a solution to this recycling quandary is critical. However, it's possible to use more copper, which is more abundant than silver.

PV Industries co-founder James Petesic has been investigating various technologies through partnerships with the University of New South Wales, which has developed a catalyst for making a thermal pyrolysis process more efficient and Deakin University, which has invented a process to safely extract silicon from the panels. But it has not yet settled on a solution that can be commercialised.

Can't we R&D our way out of this?

On first glance, chemical recycling techniques sound like a magic bullet solution because they can extract critical minerals from the panels. In France a facility called ROSI, which will open at the end of June, claims to be able to extract 99 per cent of a panel's material, including the silver. However, chemical recycling techniques have largely not been commercialised because they are expensive and involve large amounts of energy. And they are not especially environmentally friendly.

"Chemical recycling is not an easy process because you are left with toxic by-products and waste. We need to think about downstream impact of chemical processing and devise a circular solution for the solar industry," Petesic told *The Fifth Estate*.

Another difficulty with recycling is to ensure the various components of panels are not contaminated, so they can be reused to make new high-grade materials. For this reason, recycling processes that involve crushing panels and using electromagnets to recover the precious materials are viewed as inferior.

Going full circle

Perfecting the recycling technique is only one aspect of the circular solution that is needed for PV panels.

As with all forms of waste, there must be a collection process and an incentive for manufacturers to opt in. It will be mandatory for manufacturers to join the national product stewardship scheme by 2025, where they will have to pay a fee for panels to be collected and recycled. This system already exists in Europe, with fees used to pay for collection logistics and for R&D into the development of new technologies.

Refuse, redesign and reuse are other chinks in the chain that circular economy experts recommend we focus on. Some abandoned solar panels are still functional, according to Petesic.

The company has developed a web application that can test the quality of the panel and determine whether it can continue to be used. Further up the waste hierarchy still is to make better quality panels in the first place, according to Circular Australia chief executive Lisa McLean.

"Solar panels can be manufactured with fewer toxic components, or redesigned so they can be more easily disassembled at end of life," she said.

Making fewer panels (the *refuse* part of the hierarchy) is also recommended, but this will require us to reduce our electricity consumption, which given the transition to full city electrification and the emergence of hydrogen, feels unlikely.