Senate Environment and Communications References Committee
Inquiry into waste reduction and recycling policies

ANSWERS TO WRITTEN QUESTIONS ON NOTICE
Commonwealth Scientific and Industrial Research Organisation (CSIRO)
14 February 2025

In relation to—

Senator GROGAN: … I'm keen to understand the research that you are doing into plastics and recycling. My understanding is that you're doing quite a lot, but I wonder if you could step through the span and width of that.

…

Dr Molony: I can follow up afterwards, but, at a very high level, there are a range of initiatives. One is looking at replacement of plastics in a range of uses, like cling wraps and other applications. That's a collaboration with our university partner in Western Australia. We're also supporting small companies and start-ups looking at using algal sources for a biodegradable plastic-type arrangement. Again, after this, I can provide more information around that or link you to the right people. One other part is using insect larvae to digest some forms of plastics. There are some insects—black soldier fly, for one—that have an enzyme that can break some forms of plastic down. We're looking at whether we can use that enzyme in other applications as well.

Senator GROGAN: I would love to know more about that. That would be really useful.

Question

1. What is the span and width of CSIRO's research into plastics and recycling?

Answer

Research by CSIRO and our partners aims to change the way we make, use, recycle and dispose of plastics. Recognising that a systems scale change is required, and no single intervention will be able to achieve the targets for reduction in plastic waste and pollution, the four key focus areas of our Ending Plastic Waste research aim to address the entire life cycle of plastics:

1) Upstream design
2) Resource recovery
3) Knowledge and data
4) Global and education initiatives

1) **Upstream Design** (focussing on preventing waste generation through better material and product design)

Biodegradable and Compostable Plastics

a) Using internationally recognised standards and test methods we are investigating materials that produce compostable plastics, as well as undertaking research to improve technology for producing bioplastics from renewable resources.
b) We have developed an innovative sprayable biodegradable membrane called TranspiratiONal-SBM. It allows farmers to control weeds, increase crop yields, and conserve water whilst eliminating the use of plastic mulch films.
c) Our Bioplastics Innovation Hub (https://www.csiro.au/en/news/all/news/2024/september/csiro-murdoch-university-launch-bioplastics-innovation-hub-to-end-plastic-waste) partnership with Murdoch University has been established to develop cutting-edge 100 per cent compostable plastics. The hub will work with industry partners to develop a new generation of compostable bio-derived packaging.
d) We've produced the *State of bioplastics in Australia* https://research.csiro.au/ending-plastic-waste/bioplastics-report/ report to better understand bioplastic materials and their integration in Australia's waste streams.

Sustainable Polymer Design

a) Developing design principles for plastic products that prioritise durability, reusability, and recyclability. This includes "design for disassembly" concepts.
b) Research into alternative materials that can replace conventional plastics in certain applications (e.g., natural fibre composites).
c) Life cycle assessments (LCAs) of different materials and comparative products to quantify their environmental impacts.

2) **Resource Recovery** (focussing on improving recycling, waste management, and turning waste into valuable resources)

Advanced Sorting Technologies

a) Development of sensor-based technologies using AI and machine vision to improve the accuracy and efficiency of plastic waste management. Smart Bin technology https://www.csiro.au/en/news/all/articles/2022/august/smart-bin-technology , AI Bin auditor technology.
b) Research into automated systems for separating different types of plastics and removing contaminants.

Chemical and Advanced Recycling

a) Investigating various chemical recycling processes (e.g., pyrolysis, depolymerisation) to break down plastics into their basic building blocks (monomers) for reuse in new plastic production. https://www.csiro.au/en/research/environmental-impacts/waste-management
b) Developing catalysts and optimising processes to improve the efficiency and yield of chemical recycling.
c) Assessing the environmental and economic viability of different chemical recycling technologies.

d) Enzymatic decomposition: We are designing new variants of bioplastic degrading enzymes to improve their activity and thermostability.
e) Insect digestion: Developing optimised enzymes and transferring the gene codes in these enzymes to other organisms, such as the black soldier fly to more efficiently process plastic waste. https://research.csiro.au/microbiome/precision-engineering-of-the-black-soldier-fly-gut-microbiome-for-sustainable-waste-management/
f) Mechanical Recycling Optimisation - Research into improving the mechanical recycling process for plastics such as PVC.

3) **Knowledge and Data** (focussing on gathering and analysing data to understand the problem, track progress, and inform decision-making)

Microplastics Monitoring and Analysis

- Developing standardised methods for sampling, analysing, and quantifying microplastics impacts in different environmental matrices (water, sediment, biota). https://research.csiro.au/microplastics/

Marine Debris Tracking and Modelling

- Using oceanographic models and data from field surveys to track the movement and accumulation of plastic debris in the ocean. https://research.csiro.au/marinedebris/
- Developing predictive models to identify sources of plastic pollution and forecast future accumulation zones.
- Using remote sensing technologies (Aquawatch Hydraspectra) to monitor plastic pollution.

Data Platforms and Visualisation

- Developing online platforms and tools to share data on plastic pollution, waste management, and research findings. Development of the DCCEEW National Plastic Pollution Portal.

4) **Global and Education Initiatives** (focussing on international collaboration, knowledge sharing, and raising awareness)

Indo Pacific Plastics Innovation Hubs

- Establishing partnerships with local researchers, governments, and industries to address plastic waste challenges in these regions. https://www.csiro.au/en/research/technology-futures/creating-technology/materials-manufacturing/plastics-innovation-hub-indonesia
- IPPIN Projects: Conducting research on local plastic waste issues, developing tailored solutions, and building capacity for sustainable waste management.

International Collaborations

- Participating in international research projects, delivering capability uplift and working groups focused on plastic pollution (e.g., with the UN Environment Programme, SPREP)
- Sharing expertise and data with researchers and organisations around the world.

Community Engagement and Education

- Developing educational resources and SME engagement programs (Innovate 2 Grow).

CSIRO's circular economy research also provides innovative applied science to increase sustainable waste recovery for government, industry and communities: https://www.csiro.au/en/research/environmental-impacts/sustainability/circular-economy

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In relation to—

Dr Schandl: … We've done a report on the technical and engineering potential for advanced recycling, which I believe also includes an analysis of the economics of that process. We'd be very happy to table that report subsequently.

Senator GROGAN: Can you table the report you've written on the technical and engineering potential of advanced recycling?

Question

2. Can you table the CSIRO's report on the technical and engineering potential for advanced recycling?

In relation to—

Dr Schandl: … We've done a report on the technical and engineering potential for advanced recycling, which I believe also includes an analysis of the economics of that process. We'd be very happy to table that report subsequently.

Senator GROGAN: Can you table the report you've written on the technical and engineering potential of advanced recycling?

Answer

CSIRO's report, *Advanced recycling technologies to address Australia's plastic waste* evaluates advanced recycling pathways to convert plastic waste into valuable resources to build Australia's circular economy.

The CSIRO report aims to build awareness of advanced recycling technologies, how they apply to different plastic types, and the key factors to enable adoption and scale up of these technologies in Australia.

Links to the report and webinar are available via this link: https://research.csiro.au/ending-plastic-waste/advanced-recycling/

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Questions

1. What are the current recovery rates for solar photovoltaics (PV)?
2. What tangible progress has been made in rates of recovery for solar PV?
3. Have there been any specific research projects on rates of recovery for solar PV?

In relation to—

CHAIR: In terms of one of those inputs—I don't know whether CSIRO or the industry department would be able to answer this as well—what tangible progress has been made in rates of recovery for solar PV? You mentioned revenues and costs, but what about the technical aspects of it? Is that something that there has been any specific research projects on?

Ms Bird: Some of the work that we're looking at—again, I don't have the specific breakdown here—is looking at some of the technology that's available. There are varying levels of quality of recovery. Some of that can range from just basically smashing it up to actually recovering the gold and the silver and the other critical minerals that are in there. So we're scoping that to see what gradations of quality are out there. I'd probably have to take it on notice to get to the specific recovery rates that currently exist, unless others have it to hand.

Dr Molony: Chair, we do some work not only on the recovery and the potential of recovery but also on the next generation of PV. I'll take that on notice, if you like, and provide that to your committee.

Answers

CSIRO has developed a rapid assessment capability for second-life applications of PV panels that would otherwise become e-waste, ending up in stockpiles, landfills, or recycling. We have also partnered to rapidly triage PV Panels in conjunction with the Smart Energy Council and its PV Solar Stewardship Pilot project to evaluate the costs and commercial viability of large-scale solar panel collection for re-use applications *(https://smartenergy.org.au/programs/solar-panel-recycling-pilot/)*.

CSIRO (Energy), Newcastle University, and PV Industries (a solar waste management and recycling company) are collaborating on resource recovery from solar panel eWaste. So far, two papers have been published on recycling and recovering PV materials as part of this ongoing collaboration. This research aims to create a roadmap, in the Australian context, to identify and reduce the cost of recovering valuable materials. Further details can be found in the following peer-reviewed publications:

1. "A Review of End-of-Life Silicon Solar Photovoltaic Modules and the Potential for Electrochemical Recycling" Authors: Jackson Lee, Noel Duffy, Jessica Allen. *Advanced Energy and Sustainability Research* 6 (2), 2400254

2. "Comparative assessment of solvent chemical delamination of end-of-life solar panel" Authors: Jackson Lee, Noel Duffy, James Petesic, Tom Witheridge, Jessica Allen. *Waste Management* Vol.190, p122-130

CSIRO is also working with other research and development providers to develop and test printed solar panels for a range of applications from on country to space. These panels can reduce the volumes of materials used in production and reduce waste streams through smarter designs.

Further information is available at these links:

1. Solar power: Printed flexible solar achieves efficiency record - CSIRO https://www.csiro.au/en/news/All/Articles/2024/March/printed-solar-efficiency-record
2. Printed Photovoltaics Facility – Printable Photovoltaics https://research.csiro.au/printedpv/printed-pv-facility/

The Department of Climate Change, Energy, the Environment and Water (DCCEEW) has advised the following:

In 2024, DCCEEW commissioned Aurecon to develop an evidence base for the costs, revenues and technical maturity of the Australian PV recycling industry. Aurecon's investigation focussed on current and emerging recycling technologies and the commodities generated. Through direct discussions with industry and desktop research, Aurecon examined the recovery efficiency of four major types of solar PV recycling, and found:

Recycling plant type	Bulk material recovery	Bulk recovery & thermal delamination	Full recovery (including silicon & silver)	Aluminium& glass recovery only
Material recovery rates				
Aluminium	73%	73%	91%	73%
Glass	92%	92%	99%	92%
Copper	41%	41%	95%	0%
Silicon	0%	0%	95%	0%
Silver	0%	0%	94%	0%
Mixed Solar Metal	0%	15%	0%	0%

Source: Aurecon Australasia (2024), Solar PV Recycling: Report prepared for the Department of Climate Change, Energy, the Environment and Water (unpublished)