Submission to the House Standing Committee on Industry, Science and Resources on Innovative solutions to Australia's waste management and recycling industries.

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The views expressed in this submission are those of the authors and not the University of Tasmania.

Summary and key points

This submission argues for a cross-disciplinary approach to solving the current waste problem in Australia. We also contend that the current waste crisis is an opportunity for new businesses in Australia, and we provide a couple of case studies which outline how this can be achieved. Both case studies show the importance of government at all levels as a broker and facilitator in this transformation. Our perspectives at the University of Tasmania are that the waste problem is now fundamentally affecting the marine environment and require systematic changes. This can only be achieved by combining insights from behavioural economics, sustainability practices, consume behaviour and science to inform policy and engage with all stakeholders in the process.

Key points

- Waste is a recurring problem which threatens bio-security and the food chain of the planet.
- Waste reduction can be achieved by new industrial models such as a circular economy which reuses waste and by the application of behavioural economics, sustainability practices and consumer behaviour to provide incentives to change behaviour.
- Waste reduction can be a economic and community resource, and two case studied supplied in this submission highlight this.
- The University of Tasmania has considerable expertise and experience working with industry and government, to help address this problem of national significance.

Overview

The problem of the management of Australia's waste and recycling industries is a significant one. The National Waste Report 2018 (Department of Environment and Energy, Blue Environment Pty Ltd, 2018) found Australia generated 67 million tonnes of waste in 2016-17, of which 58 per cent was recovered. This equated to 2,700kg for each person. While the majority of this waste comes from the commercial and industrial sectors (including construction and demolition), approximately 560kg for each person is generated by households and local government.

The National Waste Report estimates that each person generates about 103kg of plastic each year. Of particular concern is the finding that only 12 per cent of the plastic that Australians put into their kerbside bins is being recycled. The problems were further highlighted when China stopped longer accepting waste products from Australia in 2017and increased environmental concerns about plastics and microplastics in the marine food chain from krill upwards in marine species. The authors believe this is a problem requiring cross-disciplinary research, working closely with both industry and all levels of government to solve. There seems to be no technological "silver bullet" or "drop-in" solution readily available. Rather, a considered step change will be required from all stakeholders to modify logistics, manufacturing, and consumer behaviours. It is also quite likely a sequence of solutions will

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need to be deployed, in order to create this systemic change (such as, the "circular economy" which aims to minimise resource usage and waste). The development of more "circularity" in the economy has the potential to benefit the national economy, the environment and the quality of life of Australian citizens. This is discussed later in the two case studies in this submission, where it is shown that there is considerable opportunities for Australian manufacturing and regional communities to re-use waste as an impetus to the development of new manufacturing industries and alternative energy generation.

As per the terms of reference our submission seeks to address the following areas in waste management and recycling:

- Industrial, commercial and domestic waste
- Waste in the waterway and oceans
- Landfill reduction
- Other related matters.

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Industrial, commercial and domestic waste

Rationale: 'Reducing waste and turning the remaining waste into an economic resource'

The authors recognise that the Australian Government, in co-operation with the states and territories, wants to reduce plastic wastage and boost plastics recycling by strengthening the circular economy and maximising the economic value of waste plastic resources.

On 3 May 2019, the Morrison Government, committed to strengthen Australia's recycling sector and help local manufacturers deliver a healthier environment while increasing jobs in the nation's recycling industry. On 9 August 2019, CoAG agreed Australia should establish a timetable to ban the export of waste plastic, paper, glass and tyres, while building capacity to generate high value recycled commodities.

The public policy settings to reduce plastic waste and boost plastics recycling have been considered in isolation, both within and across the Australian, state and territory governments. Public policy outcomes and government investment will remain sub-optimal without a holistic approach to public policy development and implementation. The Australian Government's commitment, coupled with the CoAG agreement, provides the first realistic opportunity to address existing public policy failings. Critical considerations include:

1. Australia has a small plastic recycling market and limited infrastructure. These constraints are compounded by a market failure, whereby new plastic is cheaper to produce than recycling existing plastic. It could be argued that without market intervention, there is no incentive for manufacturers to use recycled materials. Establishing the type and level of market interventions is critical to addressing waste reduction and boosting recycling. Limited behavioural research to understand and develop recycling education programs has been conducted nationally.
2. The South Australian Government which is recognised for its national leadership in recycling practices noted in its submission to the Senate Environment Committee's 'Never waste a crisis: the waste and recycling industry in Australia' (2018) that advice and understanding of what can and cannot be recycled, can significantly impact consumer behaviour and decisions regarding waste. The South Australian Government also raised the importance of education in the effort to reduce the amount of waste going to landfill.
3. Without national and regional behavioural insights, determining the cost-effective public policy settings is unlikely. Data is notoriously poor around the waste generation and diversion across all levels of government, and there are no mechanisms for the collation of waste generation and diversion data at a national, and in some instances at a state/territory, level.

International and domestic approaches to dealing with industrial and domestic waste: Is the circular economy the panacea?

Businesses around the world are beginning to adopt "reverse logistics" or develop a circular economy as a means of limiting the amount of waste, managing costs and providing greater

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value to the business. Coca-Cola, for example, is moving to a zero-waste approach in packaging by reducing its use of plastics and developing a circular economy (Fleming, 2019). This approach mirrors the development of sustainable materials management and packaging re-use policies by the American Institute for Packaging and the Environment (Ameripen) (Lilienfeld, 2016). There is emerging research which suggests consumers value and are willing to pay for products, which have been reused as part of the circular economy (Lieder, Asif, Rashid, Mihelič, & Kotnik, 2018; Machado, Almeida, Bollick, & Bragagnolo, 2019; McKinsey Insights, 2019; Scherer, Emberger-Klein, & Menrad, 2018; Shen, Liu, Zhang, & Choi, 2019). For example, consumers in fashion report feeling more virtuous about using pre-worn or re-purposed clothing, and value companies more highly if they are involved in a circular economy (Gaur, Mani, Banerjee, Amini, & Gupta, 2019). They are also more likely to adopt packaging made from recycled or bio-based plastics, both in terms of concern for the environment and the disposal of bio-waste (Russo, Confente, Scarpi, & Hazen, 2019). It has even been suggested that the use of a circular economic approach, is a source of competitive advantage for companies, given the value place on it by consumers (Jayaraman & Yadong, 2007).

However, there are significant barriers to the development of a circular economy. The Australian Packaging Covenant (APCO), between industry and government, has been in operation for 20 years with a new strategic plan every five years and yet, there has been no universal shift towards reuse or a circular economy (Food & Beverage Industry News, 2019). Complicating implementation, is that the covenant has over 1,500 organisations and involves eight different government organisations. The organisations involved are also across a number of industry segments, which means there will be different problems and priorities to consider in each sector.

The movement to a circular economy requires changes in not just manufacturing and packaging, but also significant modification in design and materials (Marrucci, Daddi, & Iraldo, 2019). The CEO of APCO, Brooke Donnelly has commented for example, that the phasing out of single-use plastics packaging through redesign, innovation or alternative delivery methods is an important way forward to reduce waste (Food & Beverage Industry News, 2019). Circular economic business models have also been found to help generate innovation, such as bio-paint spin-offs in Italy (De Angelis & Feola, 2020) and the development of business incubators in the U.S. dealing with waste (Greenwalt, 2019). While this research is promising, it has been shown that the economics of recycling is only possible when there are higher revenues for waste for local councils (Folz, 1995). So addressing the waste issue must include the incentive to reuse and repurpose, along with enhancing the economic value to do so. There are inherent switching costs in changing any process, and given the complexities in modern economies, there appears to be an important role for government to help facilitate a move to a more sustainable future. There also seems to be a vital role for researcher and universities to help facilitate this process by providing evidence for policy changes and understanding motivations to change and barriers which may delay this.

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Some case studies of the circular economy in action in Australia, show the importance of government and suggest in part an important consideration of universities to assist government, industry and communities reduce and reuse waste.

CLEAN Cowra NSW

"Cowra Low Emissions Action Network or 'CLEAN' was established in 2007 as a community-led group which originally focussed on coordinating the bulk purchase of solar. Since 2011, CLEAN has been collaborating with local and state governments, industry and Community to develop a local biomass to energy project (Wright, Sharpe, & Giurco, 2018, p. 329). The project aimed to provide low-cost local electricity through a community-led business model, which is represented in Figure 1. The project was led by a dynamic and committed architect, helped by a local entrepreneur, and supported in-kind by local and federal governments. The local council was a key stakeholder in the project, providing financial support and was a source of municipal organic waste for processing. Expertise from the NSW government in the form of the Sustainability program, helped with the competitiveness and environmental leadership of the program. In 2015 the program was a finalist for the Global Accenture Award for Circular Economy Pioneers. The role of the government was seen as crucial in not only providing preliminary support but also in building relationships, enhancing credibility, providing stability and supporting specific outcomes (Wright et al., 2018). The role of the government going forward is also to help other communities interested in developing and scaling up such an approach.

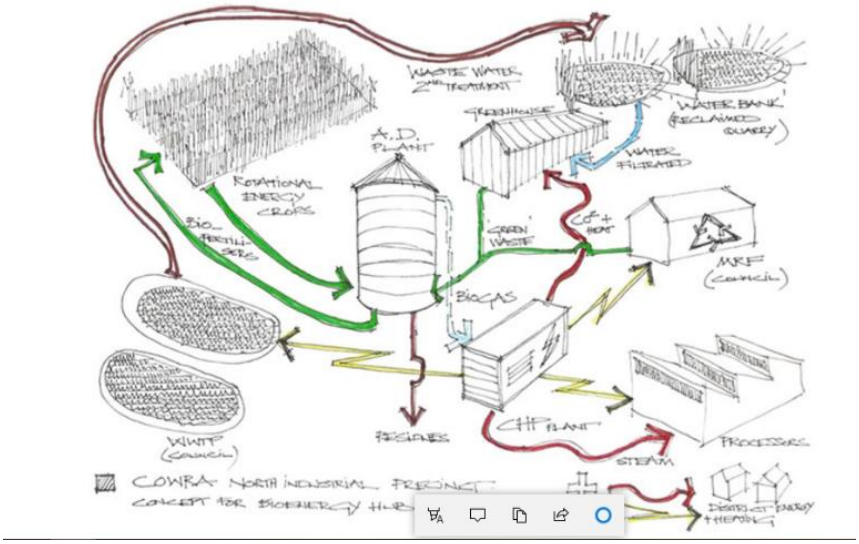

Figure 1: The Cowra CLEAN project. A local example of a circular economy. Source Wright et al. (2018, p. 330)

Envorinex. A Tasmanian company that transforms PVC waste.

Envorinex is, based in George Town, Tasmania and manufactures injection moulded and extruded products from recycled PVC (mainly window frames) and polypropylene. Its recycled product range includes noise abatement fencing, matting, beehive foundations, septic tanks, raised garden beds and guardrail delineators. The company sells 5% of its products in Tasmania, exports 55% to mainland Australia and the remaining 40% to North America, Japan, New Zealand, Papua New Guinea, the South Pacific region and Europe (Plastics News, 2013). The company uses a number of collection points to collect waste in mainland Australia, including the Oakleigh Centre for Intellectually Disabled Citizens in Victoria, where builders deliver off-cuts for the company to grind and ship to Tasmania for processing. The PVC septic containers manufactured by Envorinex are especially valued in developing countries where sanitation is lacking. In 2013, the company joined the PVC Recovery in Hospitals program, and now recycles medical products such as tubing, intravenous fluid bags and oxygen masks. This program was officially launched by Australia's peak PVC industry body, the Vinyl Council of Australia in Melbourne. Central to the success of the company has been the Tasmanian Freight Equalisation Scheme, as freight is a major expense.

Both these examples show the important role of government and industry associations as facilitators of a circular economy approach to the reduction of waste.

Waste in the waterways and oceans

The Senate Environment Committee's 'Toxic tide: the threat of marine plastic pollution in Australia' (2016) notes the significant gaps in knowledge about the effects of marine plastic pollution, including both the population-level impacts of ingestion and the effects on human health of plastics in the food chain. The Committee also notes hundreds of species of fauna including birds, turtles, cetaceans, pinnipeds and corals have been negatively affected by ingestion and entanglement. The 2016 Senate Environment Committee report, however, found limited research has been undertaken to fully understand the extent of plastic debris in our coastal areas and waters.

At the August 2019 CoAG meeting, Environment Ministers were tasked with advising on a timetable and response strategy, following consultation with industry and other stakeholders, in relation to plastic waste and plastics recycling. This presents a unique opportunity to reset the public policy framework for plastic waste and plastics recycling. Importantly there is an opportunity to present the choices, constraints and possibilities associated with managing plastic wastes and developing a plastics recycling market while minimising plastic waste impacts on human health and our environments (land, waterways and marine).

We believe there is an important role for universities, industry bodies and scientists to assist CoAG and Environment Ministers in understanding the current constraints and future possibilities and to better inform public policy choices. The following knowledge gaps which require closing are:

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1. **Quantitative understanding:** Government policy, parliamentary inquiries, industry and community groups all agree that existing quantitative analysis is inadequate in determining the actual scope of the problem.
2. **Mathematical and statistical modelling:** To inform the choices, constraints and possibilities via mathematical and statistical modelling, measurement, and research analysis. This analysis, building on the National Waste Report, will give a 'reality' to the numerical values associated with plastic waste and plastics recycling.
3. **Market(s) understanding:** Given the market failure to date, coupled with the accompanying impact on the Australian recycling industry following changes to export practices into Asia, there is a need for a quantitative and qualitative assessment of the Australian market in relation to volume and value, the various customer segments and buying patterns, the competition, and the economic environment in terms of barriers to entry and regulation.

   Analysis of prospects for projects that reduce plastic waste and help build domestic and international markets for recycled plastics is critical, particularly in relation to how new opportunities can respond to an identified need or market demand. Supply risks, market dynamics and commercialisation opportunities also need to be evaluated.

   Additional analysis is also required to identify how market opportunities will build human capability in waste reduction, manufacturing and recycling industries.

   Public policy should be informed by analysis of substitute products that offer the same or similar benefits, with less health and environmental impacts. This analysis needs to determine:

   - how advanced substitute technologies are, such as biodegradable materials
   - if substitute technologies are appealing for consumer use
   - the substitute price points and risks to supply and price changes
   - any barriers that may stop a customer from switching.

4. **Human health:** A recent collation of 50 international research papers provides an accurate calculation of human ingestion rates, which is about 2,000 tiny pieces of plastic each week. The study focused on microplastics of less than 1mm, which are the most commonly ingested contaminants. Bottled and tap water was the largest single source of plastic ingestion and of the consumables, those with the highest recorded plastic levels included shellfish. Although ingestion levels have been quantified, research is required to understand the actual human health impacts of ingesting plastics.

5. **Environmental impacts:** While this finding is consistent with state and territory reporting, collation of the national research effort is required, so that the extent of the knowledge gap can be determined. The collation of research into prevention technologies is also required to evaluate the technologically feasible options available

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to reduce the level of plastic and other pollutants reaching waterways and marine areas.

6. **Behavioural insights:** Increasingly, public policy options are informed by an inductive approach to policymaking that combines insights from psychology, cognitive science and social science. Empirically-tested results to discover how humans actually make choices to assist in reducing the use of plastics and to improve the recycling of waste plastics would create policy possibilities not yet realised. This analysis would link behavioural insights to reducing health and environmental impacts as well as reduce use and increase recycling.

Opportunities for dealing with plastic waste in oceans

In addition to determining the root cause, the delivery of innovative national and international research would have a regional benefit, including throughout the Pacific, where the issue of waste plastics is a significant social and environmental issue. The benefits of this research would directly contribute to the Australian Government's Pacific Partnerships Program, by sharing health impact analysis, environmental research findings and new approaches to managing and recovering residual plastic waste. The University of Tasmanian has directly relevant research partnerships across the Pacific, including research on the prevalence of plastics in Pacific Island fish and the accumulation of beach-based plastics on Pitcairn Island.

Landfill reduction

Landfill reduction can be achieved via a three-pronged approach: reduce, reuse and recycle. Waste generation can be reduced, for example, by encouraging households to choose products without packaging and which are longer living. Households should also be steered towards repairing and reusing products, instead of replacing them when faulty. For unavoidable waste, households should to be encouraged to properly sort waste and recycle (OECD 2017).

As with most other sustainability problems today (e.g. climate change, deforestation, overfishing), landfill waste problems are rooted in human behaviour (Vlek and Steg 2007). For example, laziness as well as lack of information and awareness are the main reasons people put their recyclable waste into garbage instead of recycling bins (Guan 2019). Waste management solutions, however, often overlook the essential role that households' behaviours play, tending to focus instead on technological breakthroughs and structural changes within our societies (Linder et al. 2018; Geislar 2017).

In this part of the submission, we focus on behaviour change as a solution to landfill problems. Policies to bring about behaviour change can be based on price or on behavioural

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insights. The former utilises traditional market-based instruments, such as taxes and subsidies, to induce economically rational changes in behaviour. The latter, which is our particular focus, applies behavioural insights to address behaviours that deviate from rational economic predictions.

Nudging: Policies based on behavioural economics insights

Behavioural economics is a research programme designed to study economic behaviour through the lens of human psychology. Traditional economics explain and predict behaviour using the assumption of instrumental rationality, i.e. decision making to maximise particular objectives based on all relevant information. However, while maximisation rendered human agents predictable on paper, what was predicted increasingly clashed with how people were found to behave in real life. Behavioural economics was developed with the agenda of enriching economic theory based on how humans actually act. Thaler & Sunstein argue in their book *Nudge* (2008) that being aware of how people actually act and the psychology underlying their behaviours will serve to improve policy design. A "nudge" policy intervention happens when the decision context is designed based on behavioural insights to steer people's behaviour into a certain direction.

In terms of sustainability, nudges have been applied successfully, for instance, to reduce energy consumption (e.g. Brown et al. 2013; Ayres et al. 2013; Kallbekken et al. 2013; Costa & Kahn 2013; Pichert & Katsikopoulos 2008), limit water, paper and towel consumption (e.g. Egebark & Ekström 2016; Schultz et al. 2007) and reduce food waste from restaurants (e.g. Kallbekken & Sælen 2013). Here, we propose nudges as a potential innovative solution to landfill problems. Compared to technological developments, structural changes or price-based policy tools, nudges appeal to human psychology and represent a lower-cost, lighter-touch approach.

Below we outline some main cognitive factors and psychological biases that affect human behaviour relating to landfill reduction, and identify potential solutions based on behavioural insights.

Systems 1 and 2

The dual-process model of human cognition recognises that people have two modes of processing information (e.g. Kahneman 2011):

- *Experiential* (System 1) – rapid and automatic, using emotion and intuition for more immediate responses; and

- *Analytical* (System 2) – conscious and deliberate, using logic and reasoning for delayed responses.

In their everyday lives, people mostly utilise their System 1, saving their limited cognitive abilities of System 2 for more complex tasks. As a result, people are biased against tasks that require conscious effort. Correctly sorting waste for recycling is such a task, compared to the more automatic act of throwing everything into one garbage bin. This is not helped by the fact that recycling bins are not designed for intuitive use, rather they are designed to fit with complex waste sorting regulations (OECD 2017).

Solutions:

Nudges need to recognise the fact that people mostly rely on their System 1, with designs and interventions that appeal to quick and automatic decision making. Some recommendations:

- Changing the physical environment to make recycling convenient and salient, for example placing recycling bins in busy places with heavy footfall or designing eye-catching recycling bins that stand out;
- Changing people's cognition so that they automatically associate waste with negative mental pictures such as overflowing landfills, for example labelling "LANDFILL" starkly on garbage bins.

Bounded rationality

The concept of bounded rationality recognises that people are not capable of making maximising decisions due to limited information and limited cognitive abilities. Instead, they rely on mental short-cuts such as heuristics, resulting in quick, satisficing decisions (e.g. Simon 1972). However, such decisions are prone to errors (e.g. Hammond et al. 1998).

Due to their cognitive and information limits, people lack awareness of the negative externalities and consequences caused by their behaviours, such as the failure to reduce and/or to recycle waste. People also suffer from cognitive overload if they are provided with too much information they cannot easily process.

Solutions:

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Information and feedback can be provided to address lack of awareness. To reduce cognitive overload, information should be provided simply and unambiguously. Information can be framed in certain ways to increase salience. Some recommendations:

- Providing feedback to households on the amount of waste they produced, particularly relative to some meaningful benchmark (e.g. amount produced in other similar households) (OECD 2017);
- Providing feedback on the externalities and consequences of households' behaviours in a vivid, tangible and relatable manner, so that the message would be actioned and remembered. For example, "If all households in [*name of local area*] would sort their food waste it would be enough biofuel to support [*number*] garbage trucks for a year" (Linder et al. 2018);
- Using labels such as "Landfill" on bins to make clear where the rubbish would ultimately end up;
- Using labels to signal the expected lifespan of a given product, to nudge purchasing decisions towards longer-living products (OECD 2017; Newell & Siikamäki 2014).

Status quo bias

People have a tendency to stick with current patterns of behaviour, i.e. to have an exaggerated preference for the status quo (Samuelson & Zeckhauser 1988). Sticking with the status quo involves less mental effort than considering other courses of action. In situations where there is not an existing pattern of behaviour, then the default option is commonly used to guide choices. For example, if a certain feature is offered with a product, unless people state that it is not wanted, the take up of that feature tends to be far higher than if people had to actively opt into the feature (Johnson et al. 1993).

The status quo bias may result in households not willing to take actions to reduce, reuse and recycle, if those are not their existing behaviours. They tend to stick to what they have always done, for example using single use products (e.g. plastic bags, straws), putting all waste into one bin, purchasing products with short lifespans, replacing products instead of repairing them, and so on.

Solutions:

The inertia generated by the status quo bias can be shifted by setting specific and measurable goals and using commitment devices to regularly follow up on progress.

Defaults can be used where people are particularly resistant to change (OECD 2017). Some recommendations:

- Changing default options to "green" ones, such as banning the provision of single use products such as plastic bags, cups or straws (e.g. Wagner & Toews 2018);
- Encouraging producers to produce modular products where faulty parts can be easily repaired, changing the default from replacement to repair (OECD 2017);
- Getting households to commit to only a certain amount of waste within a particular period, and helping them stick to it via monitoring, feedback, advice and/or incentives. This could be done at the level of the community, local council or suburb;
- Rewarding households who have achieved a certain lower baseline may generate a new positive norm. Again, this could be done at the level of the community, local council or suburb.

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Present bias

Intertemporal decisions are those where the decision maker makes value comparisons between immediate and delayed outcomes. The rate at which a person is willing to trade immediate for delayed outcomes is known as their individual discounting rate (IDR). IDR has been observed to decline with time. In other words, the longer the delay, the larger the factor by which people discount the value of future outcomes (Laibson, 1997). Put simply, people prefer short term gains over longer term benefits, i.e. they have a present bias.

By their very nature, sustainable choices require people to incur tangible costs now for (perhaps intangible) future benefits. For example, when considering purchasing a longer-life product, people may focus more on the upfront higher cost instead of the longer term benefits, or when considering sorting waste and recycling, may focus on saving time and effort instead. People often demand single use plastic bags, cups and straws for immediate convenience, rather than planning ahead and bringing their own.

Solutions:

Present bias can be countered by interventions that encourage people to engage and identify with their future selves and situations. Commitment mechanisms can be used to allow people to commit now to a future course of action. Incentives can also be provided to offset the immediate costs of actions with delayed benefits. Some recommendations:

- Showing people realistic time-progressed renderings of themselves, their children and the environment in which they live, to make salient the need to take care of the planet for future generations (e.g. Hershfield et al. 2011);
- Helping people to match their future actions with their current intentions using commitment devices. Like with the status quo bias, getting households to commit to a certain amount of waste within a particular period, and helping them stick to it via monitoring, feedback, advice and/or incentives;
- Incentivising (perhaps via subsidies or rewards) immediate acts of reducing, reusing and recycling, to offset the upfront costs of these actions. For example, discounts on council rates for households who have generated less waste compared to the mean or subsiding the purchase of longer-life products or modular products;
- Timing of interventions matter, as salience of particular issues will be heightened at different junctures (e.g. insurance purchases increase after disasters) (Slovic 1987). Campaigns to reduce landfill can be made to coincide with relevant events, e.g. World Environment Day (5th June) or after particular environmental disasters.

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Social norms and comparisons

People are social creatures who rely on social cues to guide their actions. One of the most powerful such cues is the perceived social norm. People observe others and try to do the same as them. We are more likely to perform an act if we see others doing so, especially if these people are similar to us, as this strengthens the peer effect and evokes positive responses (e.g. Cialdini et al. 2006; Elster 1989). People also care greatly about how they compare to their peers and want to be better.

Households will not take actions to reduce, reuse and recycle if these are not accepted social norms. Sometimes social norms can be negative, for example people will demand single-use plastic bags at supermarkets or throw all rubbish into one bin if they see others around them doing so. They may be aware of the negative externalities of these acts but continue doing them to avoid sticking out as non-conformist. Often people are "punished" by others for not conforming to social norms (e.g. Fehr et al. 2002).

Solutions:

Interventions based on social norms have been successfully used to promote sustainable behaviour, such as recycling (Andersson and von Borgstede 2010) and reducing plastic bag use (De Groot et al. 2013). In these interventions, messages are typically composed around descriptive social norms in a bid to encourage people to "jump on the bandwagon". In general, strategies should be aimed at making people perceive waste reduction and recycling as social norms, so that they will conform to them. Comparisons should be drawn to better performing peers, to exploit people's need to be better than others. Some recommendations:

- Providing peer feedback to households on the amount of waste they produced or the amount sorted and recycled in a particular period, compared to similar households in the neighbourhood or to the neighbourhood average;
- Messaging based on local descriptive social norms. For example, "Most people in this neighbourhood recycle their waste. Join your neighbours and recycle your waste" (e.g. Cialdini 2003);
- Using the "messenger effect" to drive messages home. The identity of the messenger matters; It helps if people can identify with the messenger in some way. For example, a campaign featuring a well-liked local celebrity or an environmental expert who urges action.

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Related matters

The University of Tasmania as a key resource for government and industry.

The University of Tasmania is uniquely positioned to help the nation meet the challenge of reducing plastic waste and boosting plastics recycling while minimising impacts on human health and our environments because we have:

- well-aligned research programs across all required disciplines (health, social sciences, business, environment (land waterways and marine) and engineering)
- critical infrastructure to conduct research
- a track record of working with governments on critical challenges
- a track record of industry collaboration with national and SMEs
- the commitment and ability to leverage our capabilities nationally through relationships with other universities in Queensland, Western Australia and New South Wales.

The authors welcome further discussion with the government on how we can best support the government to carry out this critically important work.

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