



Centre for Air pollution, energy and health Research

Position paper

Waste-to-Energy processes

What is the impact on air
pollutants and health?



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A position paper from the Centre for Air pollution, energy and health Research (CAR)

April 2019

Cole-Hunter T, Cowie C, Johnston F, Marks G, Morawska L, Morgan G, Overs M, Porta-Cubas A, on behalf of the Centre for Air pollution, energy and health Research (CAR)

Key points

- Only half of the waste that Australia generates each year is recycled. Australian governments have committed to better waste management. While there is an increased demand for energy, greenhouse gas emissions must be curbed to mitigate climate change.
- The Clean Energy Financing Corporation waste hierarchy highlights that the first step in tackling Australia's waste problem should be to reduce the amount of waste produced before considering methods for recovery (re-purpose, recycle).
- Waste-to-Energy (WtE) processes, near the bottom of the waste hierarchy, convert sorted municipal and industrial solid waste into electricity and/or heat.
- WtE involves more complete combustion, therefore lower emissions (and higher amounts of electricity per weight) of pollutants, than incinerating unsorted municipal solid waste.
- A recent assessment which estimated the effects of inhaling combustion emissions showed WtE processes had a 64% lower health risk than incinerating unsorted municipal waste. However, increased concentration of some items being incinerated may lead to greater emissions of carcinogens if appropriate management of emissions does not occur.
- A full assessment of the environmental impacts of WtE processes should be considered on a case-by-case basis to evaluate the risks and benefits of pollutant emissions and less obvious potential impacts on the local and wider community, within the life cycle of WtE and alternative/traditional processes.

About the Centre for Air pollution, energy and health Research

The Centre for Air pollution, energy and health Research (CAR) is a National Health and Medical Research Council Centre for Research Excellence in Australia. It is the only group of its kind nationally to bring together researchers focusing on the impacts of air pollution and new versus traditional forms of energy on our health.

CAR is facilitating and translating research on moving to alternative, renewable forms of energy that have the most beneficial (or least detrimental) impacts on economy, environment and health, considering a technology's life cycle. For example, CAR is assessing how a transition in domestic energy use (from solid-fuel combustion to solar-generated electricity) may reduce household air pollution and therefore reduce childhood mortality rates in some Pacific Island countries. Conversely, CAR plans to assess the potential for negative impacts from energy transitions, such as the environmental health impacts of disposal of photovoltaic solar panels at the end of their life cycle.

Background

Each year, Australia generates around 64 million tonnes (2.7 tonnes per person) of waste, of which about 30 million tonnes is recycled and about 20 million tonnes goes to landfill (1,2). In April 2018, Commonwealth, State and Territory Environment Ministers and the Australian Local Government Association made a commitment to set a sustainable path for Australia's recyclable waste, and to work together to better manage waste in general (1). The policy update document proposes strategies and milestones based on the following five guiding principles: avoidance of waste; improved resource recovery; increased demand and use of recycled products; better managed material flows; and improved information to support innovation, guide investment and inform consumer decisions (1).

Australia and the world are facing a sustainability crisis. Increasing production, consumption and use of electronic goods is increasing demand for electricity while conversely greenhouse-gas emissions must be curbed to mitigate climate change. This increased need for sustainable waste and energy management requires more efficient, resilient policies and practices, such as a circular economy that balances product life cycles (from production/generation to disposal/emission) and minimises adverse economic, environmental health and societal impacts (3,4).

CAR's view on waste management

The Australian Federal Government Department of Environment and Energy's target is to increase waste recovery nationwide from 58 per cent to 80 per cent (1). However, CAR believes the key emphasis should be on reducing material going to waste before it is recovered (re-purposed, recycled) (5). Minimising the generation of waste as a key priority will conserve resources, reduce greenhouse gas emissions, and build resilience in the face of an uncertain future for energy production and waste disposal in the region. A recent example of the uncertainty driving this policy is China's decision to stop importing Australia's waste (6).

CAR acknowledges the Clean Energy Financing Corporation waste hierarchy (2):

1. *Minimise* (prevent where possible) the generation of waste, first and foremost.
2. *Recover* and re-purpose material for other uses, when and where waste is not preventable.
3. *Recycle*, when and where possible, if waste cannot be recovered or repurposed.
4. *Derive fuel* from remaining municipal solid waste (MSW) for Waste-to-Energy plants, failing the above.
5. *Dispose of* remaining waste (non-recoverable, non-recyclable, non-RDF-compatible) in well-managed landfills to prevent harmful agents leaching into the environment.

CAR anticipates that the application of this hierarchical approach to waste management will conserve resources, including raw materials and generated energy. The further we go down the waste hierarchy (towards landfill), the higher the environmental health burden due to less materials recovered and more by-products (pollutants) released into the environment in addition to those from generation of the product.

WtE and emissions

WtE processes, also known as Energy-from-Waste, treat sorted municipal and industrial solid waste and recover energy by producing 'refuse-derived fuel' (RDF). The RDF is then combusted to produce energy, for example, electricity that can be used to power nearby communities. The World Energy Council recognises the benefits of WtE processes (7). RDF produces nearly eight times the amount of energy compared with that produced by unsorted MSW (4.4 versus 0.6 MWh/tonne) (8). WtE achieves more complete combustion at a higher temperature because RDF per weight has a higher content of combustible materials (wood, paper, plastics, textiles and rubbers) compared with unsorted MSW when incinerated (9).

WtE and health impact

Through achieving more complete combustion, WtE results in lower emissions of pollutants than incinerating unsorted MSW. A recent life-cycle health risk assessment, focusing only on the direct effects of inhaling combustion emissions, estimated that incinerating RDF had a 64% lower health risk than incinerating unsorted MSW (10). However, it is important to note that the increased concentration of items (e.g. plastics, textiles, rubber) in RDF may lead to greater emissions of carcinogens, including dioxins and chromium, than incinerating unsorted MSW (10).

The International Agency for Research on Cancer (IARC) and the United States Environmental Protection Agency have created evidence-based categories for cancer risk ('definitely', 'probably' and 'possibly') from specific emission types (11). According to IARC's weight of evidence rating, dioxin (2,3,7,8-tetrachlorodibenzo-p-dioxin) and some chromium compounds (chromium VI) emitted from RDF are 'definite' carcinogens (11). This highlights the importance of appropriate emissions engineering controls to minimise the potential impact of air pollution, including carcinogens, on public health.

New and emerging WtE technologies do not involve direct combustion but use non-combustive heating (gasification) or microorganisms to biologically digest matter (bio-digestion) and recover energy (7). Avoiding combustion addresses the immediate health concerns of exposure to combustion emissions.

Assessing the health impacts of waste incineration

A review of the epidemiological evidence of the potential health impact of all waste incineration (not including WtE processes) revealed inconsistent findings (12). Some studies found significant associations between exposure and adverse birth outcomes, lung/throat cancer and ischaemic heart disease, while other studies found no significant associations with these outcomes or other outcomes, including respiratory function and symptoms (12). In older studies, the review found consistent evidence of the presence of biomarkers related to waste products (such as organic compounds and heavy metals) in the blood or urine of incinerator workers (12) that may be avoided in newer incinerator systems. More hypothesis-driven epidemiological studies are needed.

Inconsistencies in the evidence about the health impacts of exposure to waste incineration emissions may be due to the low sensitivity of exposure assessments used in epidemiological studies (13). More studies are needed to add to the weight and reproducibility of evidence.

Next steps

There is a need for more reliable and accurate methods to measure and report on WtE emissions, to enable risk assessment/health impact assessments of such schemes. It would be valuable to compare the human health impact of WtE to alternative methods of waste reduction and disposal. A life-cycle assessment of waste streams, including reducing and recycling, would help to guide policy in this area. A full assessment of environmental impacts of waste management activities associated with WtE should consider direct pollutant emissions (detriments) and the benefits of different strategies for waste disposal and energy generation/use for the community. It is plausible that, under some circumstances, the benefits of modern, properly managed WtE facilities may outweigh the risks (14). CAR is conducting an extensive critical literature review to identify the likely positive and potential negative health impacts of WtE.

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For more information

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For more information about CAR and our work in energy transitions as well as the health impacts of air pollution, contact us at car@sydney.edu.au or visit our website: car-cre.org.au

