Submission No 120

INQUIRY INTO PROPOSED ENERGY FROM WASTE FACILITIES

Organisation:	Waste Management and Resource Recovery Association of Australia
Date Received:	31 October 2025

WASTE MANAGEMENT & RESOURCE RECOVERY ASSOCIATION AUSTRALIA

The Hon. Nichole Overall, MLC
Committee Chair
Select Committee on Proposed Energy from Waste Facilities
NSW Legislative Council
Parliament House
Macquarie Street Sydney NSW 2000
Submission via online portal

31 October 2025

To the Hon. Nichole Overall, MLC

Re: Submission to the Select Committee on Proposed Energy from Waste Facilities

WMRR appreciates the opportunity to make a submission to the Legislative Council Select Committee ("the Committee") on Proposed Energy from Waste ("EfW") facilities in NSW. The Waste Management and Resource Recovery Association of Australia (WMRR) is the national peak body representing Australia's $21 billion waste and resource recovery (WARR) industry. With more than 2,300 members from over 400 entities nationwide, we represent the breadth and depth of the sector, including representation from business organisations, the three (3) tiers of government, universities, and Non-Government Organisations (NGOs), including research bodies. Our members are involved in a range of important WARR activities within the Australian economy, including infrastructure investment and operations, collection, manufacturing of valuable secondary raw products from resource recovery, energy recovery as well as community engagement and education. In NSW, WMRR represents over 750 individual members from more than 130 entities.

WMRR strongly advocates for a systems-based approach to resource management in Australia, advancing a circular economy to drive improved material productivity through adherence to the waste and resource management hierarchy – that is, the avoidance of waste wherever possible, and the diversion of materials from landfill through design for reuse, repair, recovery, recycling and composting of resources. Where residual waste cannot be avoided, the hierarchy prefers producing low-carbon energy from fuel production or the treatment of waste for energy production (Energy from Waste or EfW) over the creation of methane from landfill. WMRR's EfW FAQ document is provided at **Annexure A**.

This review comes at a critical time. Waste projections are increasing globally with the World Bank forecasting waste generation to increase by ~55% by 2050 from 2025 levels[1] and local data proving that waste generation in NSW is continuing to increase. Between 2015–16 and 2022–23, waste volumes across the state rose from 18.7 million tonnes to 22.4 million tonnes[2] and are projected to reach nearly 37 million tonnes in 2041–42[3]. In 2022–23, around 66% of the waste generated in NSW was recycled with the remaining 7.7 million tonnes of residual waste disposed of at landfill. This means Greater Sydney's landfills will be full within ten (10) years, and WMRR would advocate that we should not be building new ones. This growth in residual material is a result of a number of issues, including population growth. However, increasingly in Australia (which is out of step globally) the lack of regulation to require generator obligations or standards for products to be designed for re-use, repair and recycling, the lack of obligation to incorporate recycled material or prohibition on the ability to include

[1] World Bank Blogs, How the world Bank is tackling the growing waste crisis (accessed 27 October 2025)
[2] NSW Environment Protection Authority , NSW waste and recycling performance data for the 2022–23 financial year (accessed 20 October 2025)
[3]2 NSW Department of Planning, Industry and Environment, NSW Waste and Sustainable Materials Strategy 2041 – Stage 1: 2021 – 2027 (accessed 27 October 2025)

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problematic chemicals such as PFAS in products, is making them unrecoverable. In the absence of these regulatory interventions, regrettably NSW will continue to need facilities that can safely manage unrecoverable residual material.

Attempts to develop EfW facilities within Greater Sydney over the last decade to address both dwindling landfill capacity and move further up the hierarchy to recovery, including the Botany Opal Paper Mill cogeneration plant and the Western Sydney Energy and Resource Recovery Centre (WSERRC) at Eastern Creek, have fallen short, despite NSW having since 2015 an *Energy from Waste Policy Statement*, establishing policy support for EfW and including technical requirements that an EfW facility must meet (such as air emission limits, and supply of suitable feedstock that could not otherwise be safely and effectively recovered). Since 2021, the *NSW Energy from Waste Infrastructure Plan* adopted by the previous government has explicitly prohibited EfW in Greater Sydney, specifying that they can only be carried out in one (1) of four (4) regional precincts. This government developed framework has resulted in the most progressed EfW projects being located in Parkes and Woodlawn. These projects remain in community engagement and preliminary planning and environmental approvals processes.

The October 2025 release of the [NSW Waste and Circular Infrastructure Plan] again confirmed that the NSW Government views EfW as a bona fide part of the waste and resource management hierarchy, and as such a preferable solution to landfill for managing residual material. The Plan prioritises streamlining planning approvals to extend or expand existing landfills where necessary, progressing EfW projects to reduce landfill reliance while protecting human health, and strengthening long-term planning for waste and resource recovery infrastructure to meet the needs of Greater Sydney's growing population. The plan also finalised the review of the [NSW energy from waste framework], which articulated that thermally treated waste streams such as municipal solid waste (MSW) require additional regulatory and process controls and must only occur in the four (4) nominated precincts (Parkes Activation Precinct, Southern Goulburn-Mulwaree Precinct, West Lithgow Precinct and Tomago Precinct). The Plan also articulates that the NSW *Clean Air Regulation* Group 6 air emission criteria – which are the reference for the NSW EPA's environment protection conditions for all EfW facilities – are comparable with the EU standards set by the European Union's 2010 Industrial Emissions Directive (IED) and the 2019 Best Available Techniques Reference Document (BREF) for waste incineration.

WMRR notes that the Committee's Terms of Reference include focused questions on the technology proposed for the Tarago (Woodlawn) and Parkes Energy Recovery Facilities (relating to the Southern Goulburn-Mulwaree Precinct and Parkes Activation Precinct, respectively) which are currently the most progressed EfW proposals. It should be noted that WMRR's comments do not reflect any specific service or technology provider. Instead, WMRR recognises that to meet the relevant regulatory controls required, reference facilities for EfW in NSW will necessarily be considered global best practice EfW facilities having benefited from than 120 years' experience in the EU.

At the outset, WMRR emphasises that the old incineration technology is very different to current technology used in EfW and these cannot and should not be directly compared. Older facilities had basic or no pollution controls, while today's facilities are designed to ensure pollution control and emissions are managed and monitored and remain well below safe limits. Emissions are drastically lower thanks to advanced flue gas treatment systems and advanced automated emission and combustion control techniques. Modern facilities also recover significantly more energy, often 25–30% which is regulated to ensure a minimum energy recovery efficiency as part of their permit (and why the terminology changed from a waste incinerator to Energy from Waste). Technology has developed greatly as well as regulations tightening over time, with automatic safeguards now in place to quickly shut down operations if emission abatement systems fail. Modern EfW facilities also recover recyclable metals from the bottom ash residue to produce an aggregate material suitable for beneficial reuse, thus avoiding landfill disposal and supporting the circular economy. The reality is that Australia by being later to adopt these facilities has benefited greatly from these advancements, ensuring that facilities built in NSW will be deploying both safe and proven technology.

This opportunity to help fully inform NSW residents and present a balanced response to the proposed EfW facilities through this inquiry, is welcomed by WMRR. Media coverage of proposed EfW facilities often typically focuses on only the community opposition, without providing a clear picture of what is being managed by these facilities and why. To assist with this, WMRR has addressed the following:

- the perceived environmental and health risks (air quality and emissions, climate change, soil and water contamination);
- suggested inconsistency with the waste and resource management hierarchy and circular economy principles, and
- community concerns about local amenity and the inequitable burden imposed on regional communities to manage Sydney's residual waste.

WMRR is hopeful that the release of the recent [NSW Waste and Circular infrastructure Plan] will assist in better understanding the need to safely manage residual material in NSW, and the needs to take a systems based approach to developing these facilities, addressing concerns and providing social license for EfW proponents. The negative focus EfW has received in the media in relation to these perceived risks has meant that there has not been - in WMRRs view – enough public discussion of why EfW is preferable to landfill for:

- environmental and health reasons, noting that modern EfW technologies utilised overseas continually meet strict best practice regulatory compliance with a level of continuous monitoring and scientific rigour that far exceeds those we currently apply to landfills;
- supporting the state's broader circular economy and net zero transition; and
- improving economic growth opportunities for the surrounding precinct via local job opportunities and co-located industrial investment.

These factors are crucial for understanding why the proposed EfW facilities are in development, and why there are more than 2,000 such facilities operating safely around the world as critical waste management infrastructure.

A preferable solution to landfill

As a solution for residual (or unrecoverable) waste, EfW does not displace higher order recovery efforts such as waste avoidance, reuse, repair, recycling or composting. EfW however does sit in the waste and resource management hierarchy as a preferred treatment method compared to landfill for residual material given it:

- Reduces landfill: diverting non-recyclable materials that cannot be composted or recycled.
- Generates energy: converting waste into a reliable, local source of base load electricity for the region.
- Supports recycling: by focusing only on residual waste, EfW works alongside existing recycling and resource recovery systems, not in competition with them.
- Improves environmental outcomes: by reducing greenhouse gas emissions from landfill and using proven, advanced combustion and emission control technologies that meet strict environmental and health standards.
- Plays a vital role in the circular economy by recovering valuable metals that would have otherwise gone to landfill.

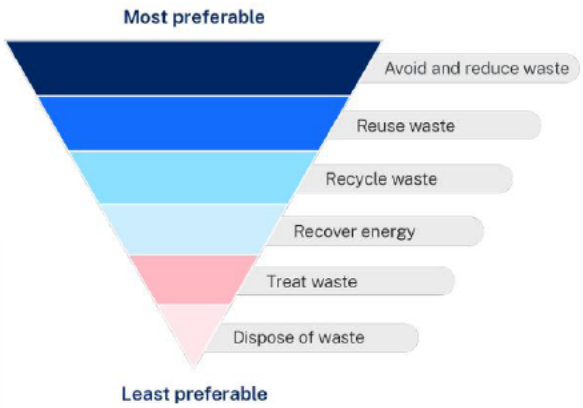

Figure 1 The waste and resource management hierarchy (Source: [NSW Waste and Circular Infrastructure Plan])

Alongside efforts targeting each stage of the product lifecycle to avoid the creation of residual waste (including design, manufacturing, consumption, reuse and repair), EfW supports the transition to a circular economy by acting as the last link in the chain after all

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other materials recovery strategies have been exhausted, to avoid residual waste going to landfill (noting that at some stage all products reach end of life).

This has been recognised in the EU, for example which has embraced EfW technology as a complement to its *Waste Framework Directive* which sets targets and requirements for the separate collection of materials to promote high-quality recycling and reuse. Up to ten (10) key waste fractions are prioritized for separate collection and sorting, though the specific number and categories can vary by Member State. These mandatory fractions include paper, cardboard, glass, metals, plastics, textiles, bio-waste, food and drink cartons, hazardous household waste, and residual waste. Energy recovery from the residual waste stream complements these efforts. Furthermore, the ability to co-locate EfW facilities alongside industrial facilities in precincts enables reduced reliance on fossil fuels, bringing both economic and environmental benefits.

EfW also assists to avoid the creation of landfill emissions. Each amount of waste that is treated by an EfW facility rather than landfilled will reduce total greenhouse gas (GHG) emissions significantly. Methane (CH_4) is emitted when organic material decomposes in a landfill in the absence of oxygen. Whilst it is acknowledged that NSW has moved to mandate separate collections of organics from households by 2030 as well as some businesses, the reality is that landfills continue to release greenhouse gases for many years, even after no new waste is added. By contrast, carbon dioxide (CO_2) is emitted when a material containing carbon is burned in the presence of oxygen, for example in an EfW facility. GHG emissions are generally reported in terms of "tonnes of carbon dioxide equivalent", abbreviated to "tCO_2e". Methane is approximately 25 times more potent a GHG than carbon dioxide[4], which means that a tonne of the methane will equate to ~25tCO_2e.

Unlike EfW, landfills remain in situ permanently, meaning that they will continue to require management of issues such as leachate and gas even post closure and may also cause environmental challenges if not managed appropriately when operating, including risks to groundwater and surface water, unpleasant odours, noise, dust, litter, and pests. Many active and old landfills are located in flood-prone areas, which are becoming more vulnerable due to climate change, such as heavier rainfall. These risks need ongoing monitoring and management, even after a landfill is closed and covered. On the other hand, EfW facilities are manufacturing facilities with an agreed life span, and carefully engineered to prevent contamination with all process fluids contained within the plant, and emissions continuously monitored and highly regulated. Operationally, EfW facilities are a base-loaded renewable energy power stations that require coordination with network operators to manage load changes and interruptions safely. Continuous monitoring and auditing ensure renewable energy claims are verifiable and that plant adjustments are performed safely, maintaining both compliance and community trust. EFW facilities can be upgraded and refurbished, ensuring continual improvement to meet the latest scientific and technological standards. Further, at end of life, EfW plants can be demolished with the land restored or the site repurposed for another use.

The role of EfW supported by the NSW government

The *NSW Energy from Waste Policy Statement* was first released in 2015, however, ten (10) years after the initial policy- there are currently no existing EfW plants in NSW. The recently released NSW Waste and Circular Infrastructure Plan has confirmed that the NSW Government correctly views EfW as a preferable solution to landfill for residual material, with the EPA committing to maintaining stringent emissions standards equivalent to world's best practice BREF and expressly noting that studies to date indicate that the risks from PFAS in emissions are low and acceptable. WMRR is hopeful that this will underscore a shift in the public consciousness about modern EfW facilities towards recognition of its role higher up the hierarchy and a more nuanced appreciation of EfW facilities as highly scientific, appropriately regulated safe technologies with proven performance and continuous improvement in overseas markets.

[4] Scottish Government, Decarbonisation of residual waste infrastructure (accessed 20 October 2025)

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The Western Australian experience is evidence that both government and regulators play a critical role in establishing both clarity of the system in which EfW rightly operates and setting clear environmental and operational boundaries, supporting social license for EfW proponents. Australia's first EfW facilities - the Kwinana Energy Recovery Facility and the East Rockingham EfW project - were permitted following the Western Australian Environmental Protection Authority (EPA) commissioning detailed studies in Europe to evaluate EfW technology, assessing both environmental and health impacts. These studies confirmed that operations adhering to best practice standards are acceptable, establishing a framework that can guide future projects. The WA Waste Authority and WA EPA issued the following statement endorsing the social license for such facilities:

> "*The EPA and Waste Authority are confident that, subject to appropriate regulation, along with the matching of suitable technologies to types of waste input and appropriate plant scale, waste to energy plants employing best practice can be operated with acceptable impacts to our community*"[5]

Figure 2 Kwinana Energy Recovery Facility Source: Ramboll

The Kwinana Energy Recovery Facility is Australia's proof-of-concept modern EfW facility, which diverts up to 460,000 tonnes of waste from landfill to recover and recycle both ferrous and non-ferrous metals and produce Incinerator Bottom Ash Aggregate (IBAA) to displace virgin material use in construction aggregates. The facility generates more than 38MW of electricity (enough to power 55,000 homes) and reducing GHG emissions equivalent to taking 85,000 cars off Perth's roads. The facility is certified by the Clean Energy Regulator (CER) to produce Large-scale Generation Credits (LGC's). According to the City of Kwinana, the facility has become an integral part of the community and economy achieving to date, 75% reduction in waste service emissions, leading to a cleaner environment and generating local job opportunities got the Kwinana industrial area. The City is anticipating an increase in its materials recovery from 19% to 49% by utilising EfW alongside a separate organics waste collection service.

Highly regulated facilities with strict emissions standards
The Terms of Reference include 'the spread of the emissions predicted and the quality of emissions to be generated' and 'the methodology of emission monitoring employed by leading large scale waste-to-energy facilities in Australia and across the world'. Any concern about such issues should be addressed knowing that proposed EfW facilities will be required to meet the emissions limits in NSW which have been confirmed by the Chief Scientist and Engineer to be among the most stringent in the world. The NSW Waste and Circular Infrastructure Plan confirms that the NSW *Clean Air Regulation Group* 6 air emission criteria are comparable with the EU standards set by the IED and BREF. This will be the NSW EPA's benchmark for setting Environment Protection License conditions for emissions monitoring and facility operations. After the proof of performance testing and 12 months of operation, the EPA will review the air emissions license limits to ensure they reflect efficient and proper operation of the plant. The results of these reviews will guide any necessary updates to the license limits.

It is also important to note that modern EfW plants use advanced flue gas treatment and automated systems to ensure emissions remain well below safe limits. WMRR has included further information about these processes in **Annexure B** (prepared by EnRiskS). Given these extensive technical and regulatory safeguards, the emissions

[5] Waste Authority (WA), Waste to energy (accessed 20 October 2025)

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from the proposed EfW facilities should not be considered an unacceptable risk. This fact is evidenced by European EfW facilities being located in the immediate neighborhood of residential areas in cities, including the Amager Bakke Facility in Copenhagen located just 1.66km away from Amalienborg – the home of the Danish Royal Family. According to the European Suppliers of Waste-To-Energy Technology (ESWET) 50% of the district heating network in Paris is supplied by energy recovered from EfW plants whilst in Sweden, EfW provides heat to 1.2 million Swedish households and electricity for another 800,000. Having these plants in close proximity to homes in cities underscores the success of the BREF in ensuring that EfW facilities operate with acceptable, low-level risks to the environment and human health.

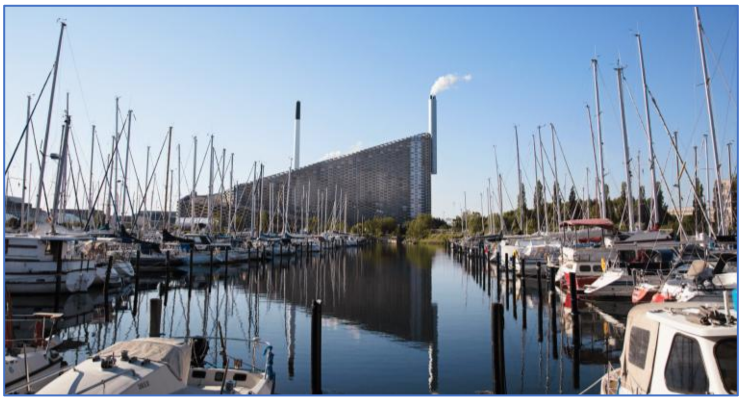

Figure 3 Amager Bakke EfW in Copenhagen

Health impacts from currently operating older technology waste incinerators as compared to the proposed newer technology

> *"Modern energy from waste is very different to older waste incineration technology and cannot be compared. Technologies for combusting waste and controlling air emissions have significantly changed and improved as better controls and improved monitoring have been developed."*[6]

Again we reiterate that modern EfW facilities are required to comply with the BREF that stipulates how the facilities operate, the level of pollution control required, sets emission limits for what can come out of the stack and outlines requirements for monitoring and management (including upset conditions). The BREF has been developed since 2000, with the most recent revision or refinement, that incorporates continual improvements, issued in 2019, and all facilities to be built in NSW will meet these standards. WMRR reiterates that studies show no evidence that pollutants emitted to air from modern EfW facilities that operate in compliance with the BREF change existing concentrations in soil or produce, and there is no evidence of adverse health effects in the community surrounding these facilities. For further information, please refer to the fact sheets from EnRiskS provided at **Annexure B.**

Closing remarks

The proposed Energy-from-Waste (EfW) facilities are clean, efficient, and capable of significantly reducing greenhouse gas emissions. WMRR emphasises that modern EfW technology is not traditional "waste incineration" that merely "burns rubbish." Instead, these facilities employ advanced, proven systems that meet strict environmental and safety standards, with continuous improvements through innovation and the application of European Best Available Technology (BAT), alongside stringent emission limits.

EfW offers a safe, proven, and sustainable solution for managing residual waste. Beyond its environmental benefits, it also brings economic opportunities — creating local jobs, reducing reliance on fossil fuels to support industries, and recovering valuable metals from residual waste that would otherwise end up in landfill.

Importantly, Greater Sydney's landfill capacity is severely constrained. Without the progression of the proposed EfW facilities, residual waste will need to be transported for disposal either interstate or to regional communities — a highly undesirable and inefficient outcome with additional environmental and social costs.

[6] NSW Energy from Waste Policy Framework (accessed 27 October 2025)

WMRR further encourages the Committee to look upstream in the value chain to address the root causes of residual waste generation. As highlighted in the recent Select Committee Report on *'PFAS Contamination in Waterways and Drinking Water Supplies Throughout NSW"*, greater focus is needed at the source — not solely at the end of the waste stream. Australia must look to the European Union's model, introducing regulations that drive better product design, increase material recovery, and are underpinned by the polluter pays principle. By holding producers accountable and incentivising sustainable design, we can reduce the generation of residual material and move closer to achieving a circular economy.

WMRR welcomes the opportunity to further contribute to this important inquiry and would appreciate the opportunity to present. Please contact the undersigned if you wish to further discuss WMRR's submission.

Yours sincerely

Gayle Sloan
Chief Executive Officer
Waste Management and Resource Recovery Association of Australia

Annexure A:
WMRR Energy from Waste FAQs

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ENERGY-FROM-WASTE (EFW) FAQS

What is Energy-from-Waste (EfW)

EfW provides a safe and proven way to manage residual waste, generate reliable energy and support Australia's circular economy.

EfW, also referred to as Waste-to-Energy (WtE) or Energy Recovery Facility (ERF), converts non-hazardous residual waste, which can't be recycled, into energy sources such as heat and electricity, and enables the recovery of other resources such as metals and construction aggregates.

EfW is critical waste management infrastructure that supports a circular economy by complimenting recycling, enabling energy recovery and avoiding landfilling and associated emissions.

Many countries, including the US, Europe and the UK, prefer EfW over landfill. There are more than 2,000 such facilities operating safely around the world.

Current technology

Modern EfW facilities are very different from the waste incinerators of the past.

Emission control
Older facilities had limited pollution control. Modern EfW plants use advanced flue gas treatment and automated systems to ensure emissions remain well below safe limits.

Energy efficiency
Current plants recover more energy – often 25–30% compared to less than 20% previously.

Regulation
Strong environmental laws now require continuous monitoring and automatic shutdowns if any system fails.

Resource recovery
Metals and aggregates are recycled from the bottom ash, reducing landfill and supporting circular economy goals.

Why EfW?

EfW provides a sustainable solution for managing non-recyclable, non-reusable residual waste that would otherwise go to landfill.

It sits in the waste management hierarchy as a preferred treatment method compared to landfill because it:

- Reduces landfill by diverting non-recyclable materials be composted or recycled
- Generates energy by converting waste into a reliable source of base load electricity for the region
- Supports recycling by focusing only on residual waste works alongside existing recycling and resource reco systems, not in competition with them
- Improves environmental outcomes by reducing green emissions from landfill and using proven, advanced c and emission control technologies that meet strict en and health standards
- Plays a vital role in the circular economy by recoverin metals that would have otherwise gone to landfill.

Waste Management Hierarchy

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READ FULL FAQS


Blue Phoenix - IBA Aggregates

Reusable residues

What types of residues are produced?

1. Incinerator Bottom Ash (IBA)
The non-combustible portion of waste - usually 20–25% of what is processed - is treated to recover metals and turned into Incinerator Bottom Ash Aggregate (IBAA) for use in road building and concrete.

2. Air Pollution Control Residue (APCr)
A fine powder collected from emission control systems, makes up about 3–5% of the waste received and is managed safely at licensed facilities or treated for reuse under strict regulation.

Air quality and health

How are emissions controlled?

EfW facilities use advanced monitoring and cleaning systems:

- Continuous Emissions Monitoring Systems (CEMS) check key pollutants such as nitrogen oxides (NO_x), carbon monoxide (CO), dust and acid gases.
- Flue gas cleaning removes particles and gases using lime scrubbers, activated carbon and baghouse filters.
- Combustion temperatures of around 850–1,100°C destroy harmful compounds.
- Independent testing verifies results and compliance.

Are emissions safe?

Yes. Emissions from modern EfW plants are well below limits set by the World Health Organization and the European Union. Studies in Europe, the UK and Australia show no increased health risks for communities living near EfW facilities.

The main emissions are nitrogen (~65%), oxygen (~6%), water vapour (~20%), and carbon dioxide (~10%).

Myths and facts

Is Europe closing EfW plants?

No. With more than 500 operating plants in Europe[1], EfW remains a key part of the waste management hierarchy. Some older plants are being replaced, but EfW continues to support the EU's Circular Economy Plan.

At least six (6) new UK projects have been announced in the past two (2) years.

Does EfW discourage recycling?

No. Countries with the highest recycling rates also have the most EfW capacity. EfW is designed to treat waste that cannot be reused, recycled or recovered.

Does EfW support the circular economy?

Yes. EfW recovers metals and other resources that would otherwise go to landfill.

Up to 25% of residual waste can be turned into Incinerator Bottom Ash Aggregate (IBAA), used in road construction and concrete production.

Australia's Energy-from-Waste Facility

ACCIONA owned Kwinana is Australia's first operational Energy-from-Waste (EfW) facility. It diverts up to 460,000 tonnes of waste from landfill each year and generates 38 megawatts of baseload electricity for the Western Power grid – enough to power more than 50,000 homes.


Kwinana Energy Recovery facility

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READ FULL FAQS

Annexure B:
Energy from Waste Fact Sheets from EnRiskS

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Energy from Waste (EfW) and community health

A bit of history

Most power stations use turbines to generate electricity. These turbines can be run by combusting a fuel such as coal or gas (or using the force of flowing water – hydropower for example). The combustion process produces steam, that then turns a turbine to generate electricity. This process has been around for a long period of time. Instead of combusting coal or gas, EfW facilities combust waste to produce steam, which turns the turbine to generate electricity. Both steam and electricity can be used from these facilities. Only waste that cannot be recycled or reused is sent to an EfW facility, otherwise these materials would end up in landfill.

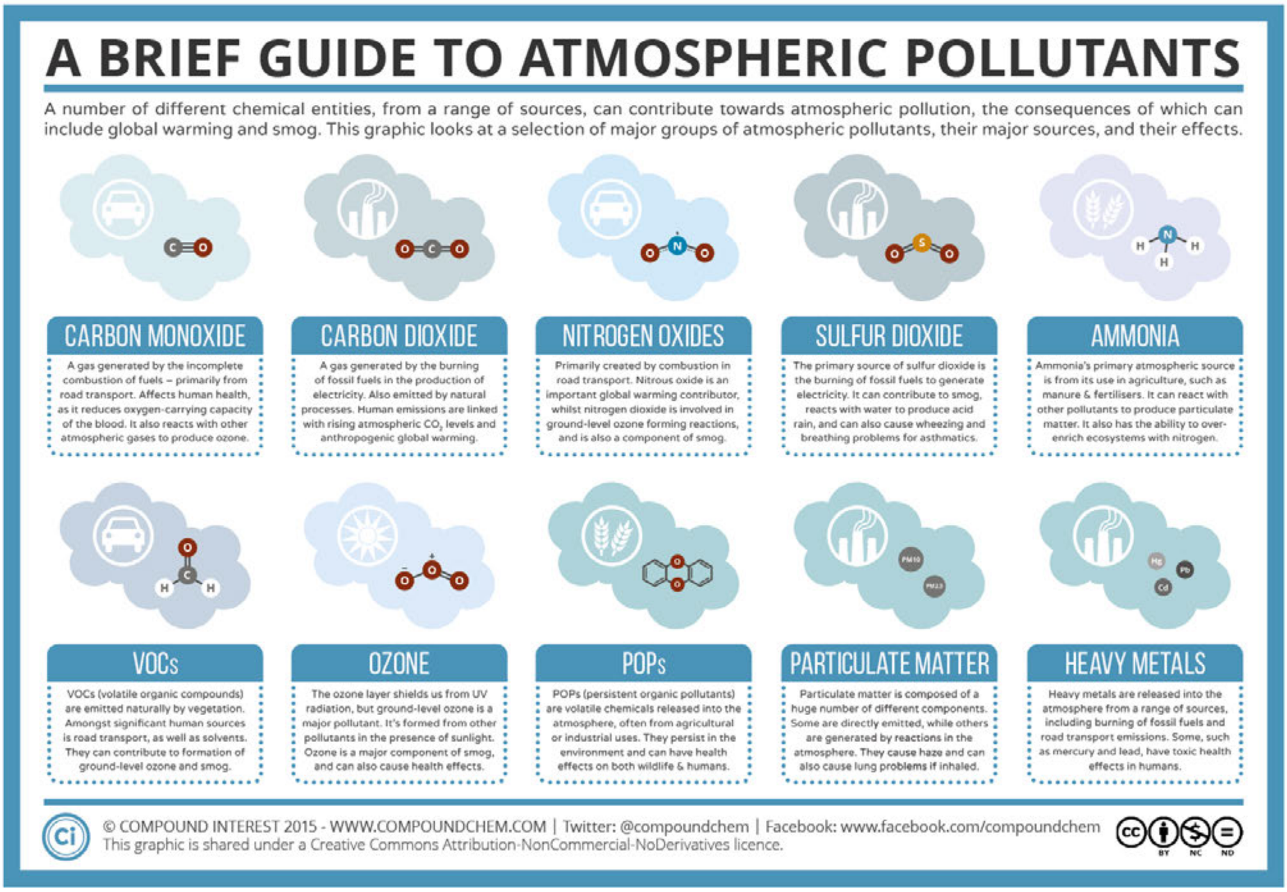
Waste incineration has been around for a long time with large scale incineration being conducted since the late 1800's and continuing into the 1900's. These facilities typically combusted waste for the purpose of waste disposal/destruction rather than to generate power. Some of the facilities in the 1900's were also used to generate steam and electricity. These older facilities had little to no control on emissions, and that resulted in adverse health impacts in the community. When clean air legislation was enacted, most of these facilities were closed.

Old incineration technology is very different to new technology used in EfW and these cannot be directly compared.

Modern EfW facilities are required to comply with EU Best Available Technologies (BAT BREF) [1-5] that stipulate how the facilities operate, the level of pollution control required, sets emission limits for what can come out of the stack and outlines requirements for monitoring and management (including upset conditions). The BREF has been developed since 2000, with the most recent revision or refinement, that incorporates continual improvements, issued in 2019.

Chemicals in air and what we breathe

It is important to remember that just like the earth (soil, rocks and water), the air is made up of chemicals. The air we breathe every day comprises nitrogen, oxygen and carbon dioxide as well as lower levels of many other chemicals. This includes chemicals from dust which includes the metals that are present in soil; pollen/spores and decomposition gases from plants and organic material; chemicals from combustion – like from running a car or truck, or using a wood fired heater or gas cooker; or dust and gases from bushfires. As a result, the air we normally breathe has low levels of a wide range of chemicals in the form of gases and particulates.



Chemicals are present in the atmosphere from numerous sources that include a range of combustion gases, metals and persistent organic chemicals like polycyclic aromatic hydrocarbons and dioxin-like compounds. These are the same chemicals in emissions to air from EfW. It is important to understand what changes in air quality may occur from the operation of an EfW facility.

To understand how the operation of an EfW facility could impact on community health, this requires some understanding of how an EfW facility operates and what could be released into the air, for the community to be exposed to.

How does EfW work and control air emissions?

The technology used in EfW has been refined to maximise energy production and minimise losses including emissions to air, specifically [2, 6]:

- Waste is mixed in a bunker prior to entering the combustion chamber or furnace, so that the fuel used provides a consistent energy input
- The furnace is required to operate at a minimum temperature and waste is combusted for a minimum amount of time, under specific oxygen conditions to maximum combustion (destruction of chemicals in the waste) and minimise the generation of pollutants including the formation of dioxins
- Heat from combustion is used to make steam – this drives a turbine to produce electricity. Both the heat and electricity can be used by other industry or electricity sent to the grid

- Ash is produced in the chamber (like it does in a wood stove) and this can be cleaned up (metal removed) and reused for things like aggregate in roads
- Emissions from the furnace are treated by pollution control equipment before being discharged to air via a tall stack
- What remains in air emissions are primarily atmospheric gases like nitrogen with trace (or very low) levels of pollutants
- EfW facilities have continuous monitoring of a number of important parameters to make sure they are operating well – just like coal or gas fired power stations
- EfW facilities are also required to monitor a range of pollutants in the stack to make sure these meet licence emission limits – just like coal or gas fired power stations and other industrial facilities
- If something goes wrong and it cannot be fixed straight away by the operator, the facility shuts down. The first step is to stop waste entering the furnace, which prevents emissions to air occurring. It is also noted that there is no way the pollution control equipment can be bypassed at any time.

What then happens with the air emissions?

Emissions from an EfW process, after all the pollution control steps to remove pollutants from the air, are discharged to the atmosphere via a tall stack.

The stack is engineered to make sure emissions are well dispersed (i.e. mixed) in the atmosphere, before reaching anywhere that the community may be exposed [7].

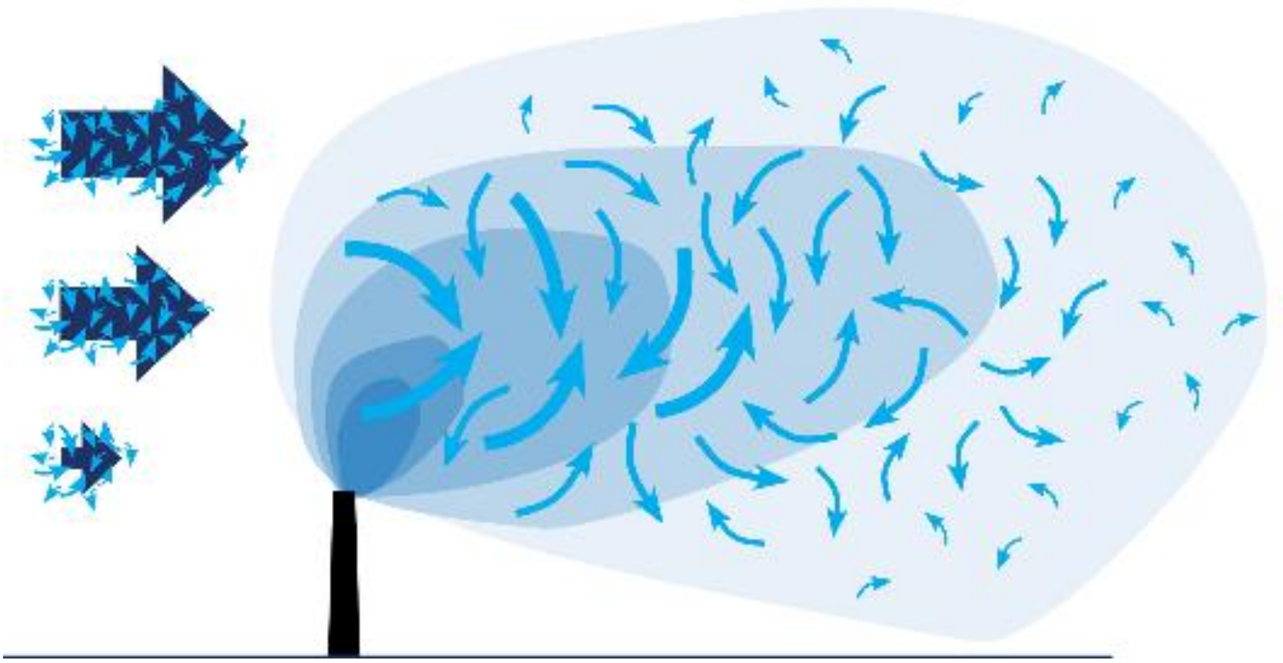


Figure showing air dispersion from a stack [7]

This means pollutant concentrations in air where the community may be present are much lower than in the stack. Concentrations in the air the community is exposed to are estimated using air dispersion models, that are reviewed and approved for use by government experts in Australia [8, 9]. These models use site-specific information such as the stack details such as the location, height, how fast the air moves out of the top of the stack, weather data and terrain, and where people live, work and play.

Assessing health impacts

Assessing whether emissions from an EfW facility have the potential to impact on health can involve conducting a detailed assessment of risks to human health and reviewing published studies.

A detailed assessment of risks to human health is required, by Australian regulations, to be conducted following Australian guidance from enHealth (2012 [10]). Such an assessment:

- Calculates how the community is exposed to pollutants from the EfW facility. It links with the air dispersion modelling to identify concentrations in air that may be in areas the community is exposed – where we may breathe the air (i.e. at ground level in the neighbouring areas). All concentrations in the environment must comply with Australian and state air quality guidelines [8, 9, 11, 12].
- The assessment also looks at the deposition of particles containing metals and persistent organic chemicals. Like all dust in the air, the dust particles can deposit to the ground where they may accumulate in soil, dust inside a home and in water. Once in soil and water the chemicals deposited with the dust can be taken up into produce that may be grown in the soil. The chemicals that may accumulate in soil from EfW are already present in soil from other sources like metals from the earth's crust, fertilisers, controlled burning and bushfires. Exposure to these may occur as a result of ingestion (incidental intakes of soil and dust, drinking water and eating produce) and absorption through the skin (for soil and dust that gets on the skin and water when bathing or swimming for example).
- No EfW facility can be approved if exposure to pollutants in all these ways added together could result in adverse health effects for any members of the community.

The potential for the community to be exposed to chemicals from the operation of an EfW facility, or experience health effects can also include a review of published studies from EfW facilities operating in other jurisdictions. This is the same for all other industrial facilities that currently or may want to operate in Australia.

For modern EfW facilities that operate in compliance with the EU BREF, such studies [13-24] show that there is no evidence that pollutants emitted to air from a modern EfW facility change existing concentrations in soil or produce, and there is no evidence of adverse health effects in the community surrounding these facilities.

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Energy from Waste (EfW) and PFAS

What are PFAS and why are they in our waste?

Per- and poly-fluoroalkyl substances (PFAS) are a family of man-made fluorine-containing chemicals that have unique stain and water-resistant properties. PFAS are a complex group of chemicals, which consists of compounds with carbon-fluorine solid bonds (C-F) which is the shortest and strongest known covalent bond in nature and is responsible for the thermal and chemical stability of PFAS.

These chemicals were developed between the 1930s and 1950s for a wide range of uses. Only since the 2000's have analytical methods been developed to be able to measure these chemicals in the environment. The unique properties of PFAS (which make them so useful in many products) also mean that once in the environment these chemicals are persistent and generally mobile, with some of PFAS chemicals also able to bioaccumulate.

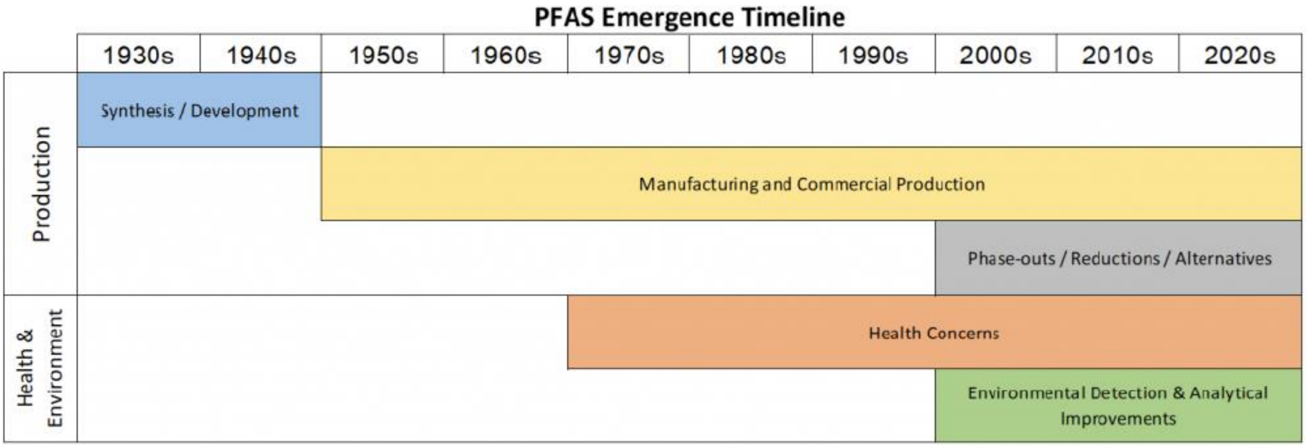

Figure 1: General timeline of PFAS emergence and awareness (from ITRC [1])

Due to the widespread use of PFAS in many products (**Figure 2**), PFAS is present at low concentrations in waste – municipal solid waste (MSW) and construction and demolition waste. MSW does not include PFAS from key source areas such as fire fighting foams, manufacturing wastes and other industrial processes.

While the manufacture, import and use of PFOS and PFOA were banned in 2025 in Australia, and levels of these compounds would be expected be reducing in waste post 2025, consumer products contain many other PFAS compounds that would remain in waste.

Studies that have looked at MSW waste found that PFAS was present in a lot of different waste materials (**Figure 3**) with household waste being the largest contributor [2].

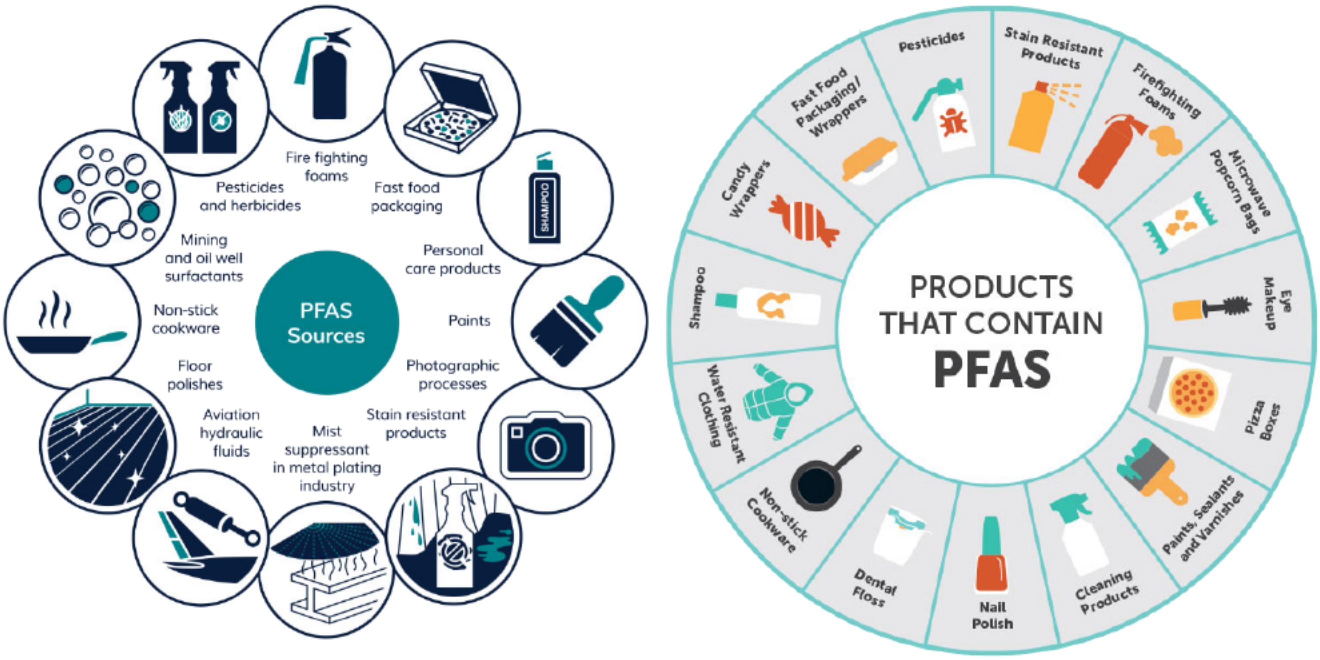

Figure 2: Key sources of PFAS (from Australian Government[1]) and key products that contain PFAS [2]

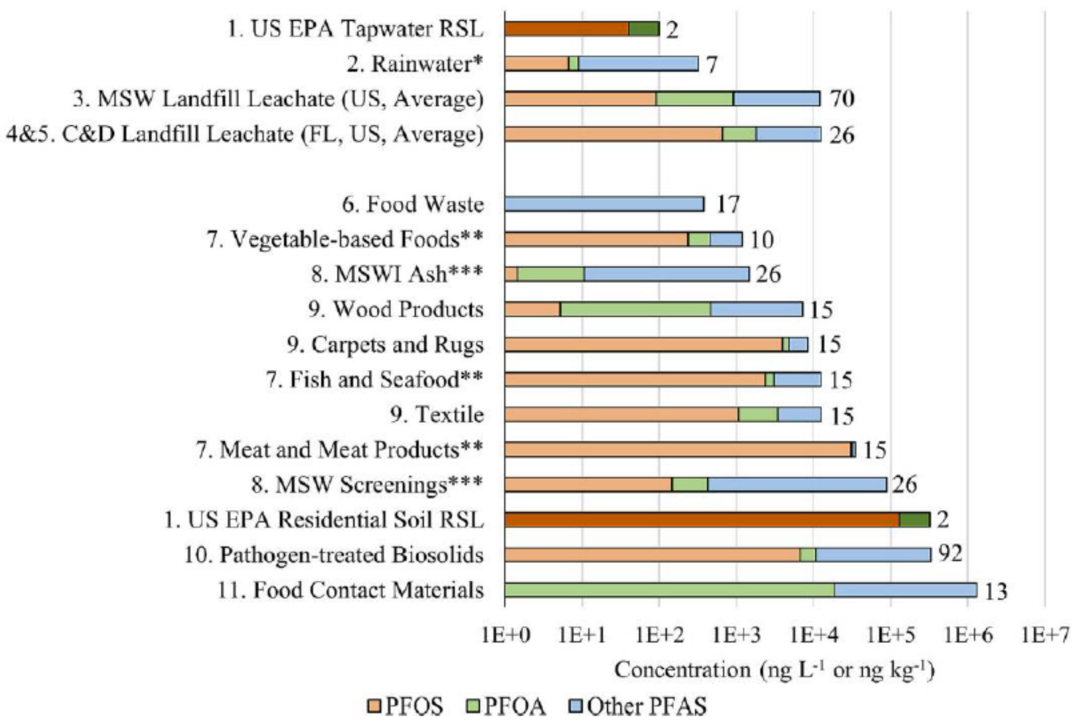

Figure 3: PFAS concentrations and compositions measured in various products, wastes and environment compared with PFAS in leachate at MSW landfills [2]

[1] https://www.infrastructure.gov.au/infrastructure-transport-vehicles/aviation/pfas-your-questions-answered

[2] https://watermanaustralia.com/pfas-contaminated-water-treatment-techniques/

Where waste is disposed to landfill PFAS migrates to leachate which requires management. PFAS (in particular the volatile PFAS chemicals which are short-chain chemicals) are also present in landfill gas. Hence PFAS are already in the environment as a result of the disposal of waste to landfill.

EfW only receives PFAS as a low-level contaminant from MSW (as above). EfW cannot accept high concentrations of PFAS waste from firefighting foams, industry or contaminated sites.

What happens to PFAS in EfW?

There is a requirement under the Stockholm Convention to manage PFAS in waste in a way that the chemicals are destroyed or irreversibly transformed or disposed in an environmentally sound manner. Australia is a signatory to the Stockholm Convention.

Incineration of solids and liquids has been identified as one of the few technologies that can “potentially destroy PFAS” [3-5], compared with many other technologies for treating PFAS contamination which rely on absorbing the chemicals to another media (just like a home water filter absorbs chemicals from water prior to coming out of a tap) or techniques to concentrate the PFAS for disposal.

Mineralisation is the more correct term to describe the process of complete breaking down PFAS molecules into base elements and compounds. This means the entire PFAS molecule (alkyl chain (tail) and functional groups (head)) are defluorinated and converted into fluoride salts, hydrogen fluoride and small hydrocarbons.

The carbon–fluorine bond in PFAS is much stronger than the carbon–chlorine bond in chemicals such as dioxin-like compounds. Breaking the carbon–fluorine bond requires 1.5 times more energy and therefore higher temperatures and reaction times. Hence the temperature and residence time for breaking the bonds in PFAS need to be considered. Concern has been raised in relation to the formation of products of incomplete combustion (PIC), where carbon-fluorine fragments recombine [5].

So, when PFAS is in waste that goes into an EfW facility the things that need to be looked for are PFAS that may not have been destroyed and PIC (**Figure 4**).

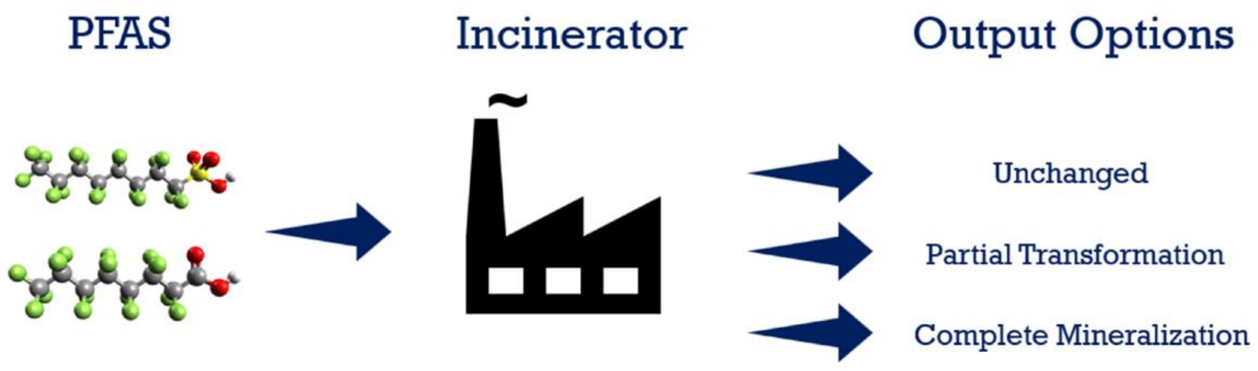

Figure 4: PFAS and incineration [6]

In an EfW facility PFAS is removed from the waste through destruction in the combustion chamber, and through the implementation of pollution control equipment to capture and remove residual gases and particulates.

Combustion conditions*

- Temperature and residence time are important to break the C-F bonds
- EfW conditions have been found to result in high levels of destruction of PFAS (more data is required)
- Products of incomplete combustion (PIC) potential – short chain PFCs

*Combustion conditions required to be used in EfW have been shown to be effective in destroying PFAS and minimising the formation of PIC [5, 7-12]

Acid gas treatment**

- Removes acid gases from emissions
- Also captures breakdown products and PIC from PFAS

Activated carbon**

- Proven method to adsorb and remove key PFAS - commonly used to remove PFAS from water

Baghouse**

- Chemicals attached to particles are captured in baghouse
- Includes PFAS bound to particulates
- PFAS removed are present in air pollution control residues (APCr)

** Air pollution control steps that also remove PFAS from air following combustion [3, 5] before being discharged to air via the stack

Are there studies that have looked at PFAS emissions from EfW?

There are a number of studies that have been conducted to assess the effectiveness of EfW in destroying PFAS as noted above. It is noted that more studies are required to further support these outcomes.

The EU BREF does not currently include any requirements for the sampling or analysis of PFAS in emissions from any waste incineration process. There are studies that have been conducted where measurements have been done to look for PFAS in emissions from EfW facilities.

The few studies available on measured levels of PFAS in stack emissions from operating EfW facilities, have reported very low level detections of some short-chain PFAS (noting methodological issues with this study) or no detections of PFAS in emissions [10, 13, 14][3].

In bottom ash PFAS were either not detected or at low and variable levels [15, 16]. Some PFAS with less than nine carbon atoms have been detected at low concentrations in air pollution control residues [15, 16].

Can the presence of PFAS in emissions be of concern to community health?

PFAS are persistent organic pollutants (POPs) and these are assessed in the same way as other POPs that may be present in emissions to air from the operation of an EfW facility. This involves following Australian guidance [17] on assessing risks to human health. This is the approach that is recommended by the NSW Chief Scientist [18]. The same as other POPs a risk assessment is required to assess all the ways the community may be exposed to PFAS. This includes inhalation as well as the deposition to soil and water, and potential uptake into produce that may be consumed. No EfW facility can be approved unless there are no risks to human health from being exposed to all emissions, including PFAS and other POPs.

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