AUSTRALIAN REFUSE-DERIVED FUEL

FUEL PRODUCT OR PLASTIC WASTE EXPORT IN DISGUISE?

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NTN NATIONAL TOXICS NETWORK

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AUSTRALIAN REFUSE-DERIVED FUEL: FUEL PRODUCT OR PLASTIC WASTE EXPORT IN DISGUISE?

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IPEN is a network of over 600 non-governmental organizations working in more than 120 countries to reduce and eliminate the harm to human health and the environment from toxic chemicals.

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National Toxics Network (NTN) is a not for profit civil society network striving for pollution reduction, protection of environmental health and environmental justice for all. NTN is committed to a toxics free future.

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KEY FINDINGS

This report has investigated Australia's claim to ban exports of its waste, particularly plastic waste, and has found the following:

- The Australian Government and industry are pouring billions of dollars into plastic 'reprocessing' infrastructure and 'Advanced Recycling Technologies', which predominantly involves the production of Refuse Derived Fuels.
- Australia's claim to stop waste exports is misleading as they intend to support the repackaging of plastic and other waste as a fuel to burn in Southeast Asian countries where they previously exported plastic wastes.
- The Australian government is avoiding regulation of plastic waste exports under the Basel Ban Amendment by claiming RDF is a 'product' not a 'waste', thereby avoiding its international legal obligations.
- Australia is one of the world's highest per capita generators of single-use plastic waste with very little ability to recycle or manage such waste.
- The largest corporate waste management companies in Australia are investing in RDF and expanding their capacity to sell it in Australia and export it to Southeast Asia.
- RDF and its derivatives PEF and SRF have a high potential to generate chlorinated and brominated dioxins when they are burned as fuel due to the additives present in the plastic waste.
- Burning plastic waste for fuel has serious environmental and human health implications, including toxic persistent organic pollutant emissions and greenhouse gas emissions.
- Australia is allowing the burning of RDF and similar plastic-based waste in cement kilns instead of moving to clean fuels like hydrogen to manufacture cement as Europe is doing. This maintains a fossil fuel-derived energy base for industry which is neither renewable nor sustainable.

EXECUTIVE SUMMARY

Australia is in the midst of the biggest waste recycling and reprocessing infrastructure build out in its history. This follows the Prime Minister's announcement in 2019 that all waste exports would be banned from Australia, after China's National Sword policy implementation and associated actions in other Asia Pacific countries. These policies effectively ban plastic and other waste exports from Australia to other countries, and especially to Southeast Asian destinations.

While this 'world first' waste export ban decision received international acclaim, closer scrutiny reveals that, in fact, Australia is gearing up with substantial public and private funding and plans to continue to export its waste in a new "reprocessed" format. A large part of this 'reprocessing' is to create refuse-derived fuels (RDF), which are bales or pellets of mixed waste to be burned in cement kilns or other industrial furnaces.

This has implications for the environment and human health due to the inherent toxicity risks and hazards of petrochemical based plastic waste containing toxic additives — risks and hazards amplified when waste is burned. It also has major implications for climate change as plastic fuels are derivatives of fossil fuels. Burning plastic waste, including as a "reprocessed fuel product", is neither recycling nor clean energy.

The new policies appear to be a cynical ploy to offload the burgeoning quantities of plastic waste Australia generates, while claiming to invest in domestic 'recycling' and banning waste exports. Australia is one of the biggest generators of plastic waste per capita globally, and is set to increase amid predictions of a five-fold increase in global plastic production by 2050 (see Figure 3).

Australia does not have a nationally consistent waste management system, with most states at different stages of implementing recently updated waste management policies. Waste collection and source separation is not sophisticated in Australia (despite industry claims to the contrary) and relies on dirty Material Recovery Facilities (MRF) to sort wastes into bales for further processing or export. There are very few plastic recycling facilities operating in Australia with only 12% of all plastics being recycled[1].

1 Department of the Environment and Energy; Blue Environment Pty Ltd, National Waste Report, 2018.

The Australian government[2] and the CSIRO[3] are promoting the RDF industry (aka Advanced Recycling Technologies) in the region and have already supported contracts with the Indonesian Government to invest in the waste to energy sector. The Australia-Indonesia Plastics Innovation Hub is a partnership between CSIRO, the Australian Department of Foreign Affairs and Trade (DFAT), and the Indonesian Ministry of Research and Technology (Kemenristek)[4].

Australia also has existing and ongoing contracts with ResourceCo, a company well established and operating in South Australia to produce RDF to burn in Australian cement kilns with subsidiary facilities in Malaysia that supply local cement kilns. ResourceCo has partnered with major corporate waste managers Suez and Cleanaway in the production of RDF in Australia and have major expansion plans for Australia and Southeast Asia exports.

Our investigation report details the status and plans for Australian waste to be exported as RDF and other classified fuels to Indonesia, Malaysia and the Philippines especially, as well as to other parts of Southeast Asia.

2 The Indonesia Australia Infrastructure Partnership (or Kemitraan Indonesia Australia untuk Infrastruktur – KIAT) Facility Design Document, Feb 2017 (final draft), Department of Foreign Affairs and Trade, https://www.dfat.gov.au/geo/indonesia/development-assistance/development-assistance-in-indonesia, and https://www.cardno.com/projects/indonesia-australia-partnership-for-infrastructure-kiat-design-and-implementation/

3 King, S, Hutchinson, SA and Boxall, NJ (2021) Advanced recycling technologies to address Australia's plastic waste. CSIRO, Australia. https://www.csiro.au/en/news/news-releases/2021/advanced-recycling-turning-plastic-waste-into-resources

4 https://research.csiro.au/ending-plastic-waste/australia-indonesia-plastics-innovation-hub/

1. INTRODUCTION

1.1 REPORT OBJECTIVE

This report is designed to inform a wide range of stakeholders and the general public in Australia and the Asia Pacific region about the policy direction Australia is taking in relation to waste management and exports. In particular, the report will focus on the waste export ban announced by the Australian Federal government and the implications of this policy for sustainable zero waste and a circular economy policy in Australia and the continued export of waste to the Asia Pacific region.


THE AUSTRALIAN

Trashed: Australia's national shame

Figure 1. Amanda Hodge, The Australian, 1 June 2019

This report attempts to provide a more robust analysis and evidence-based assessment of Australia's plans to overhaul its national waste management policies at a time when the waste disposal industry dominates public discourse, policy-making, and regulation around how Australia manages its waste. As a result, Australia is currently facing numerous incineration proposals and waste burning projects, including a major focus on the generation of Refuse-Derived Fuels for domestic use and export.


Malaysia to send up to 100 tonnes of plastic waste back to Australia

Environment minister says recycling sent from Australia included plastic bottles that were 'full of maggots'

Figure 2. Naaman Zhou, The Guardian, 29 May 2019

Waste recovery/disposal continues to be artificially boosted up in the waste hierarchy in Australia to fulfil business models of industries (cement kilns and incinerators) who want cheap waste-based fuel to burn. Without a well-established recycling sector more and more recyclable materials, including plas-

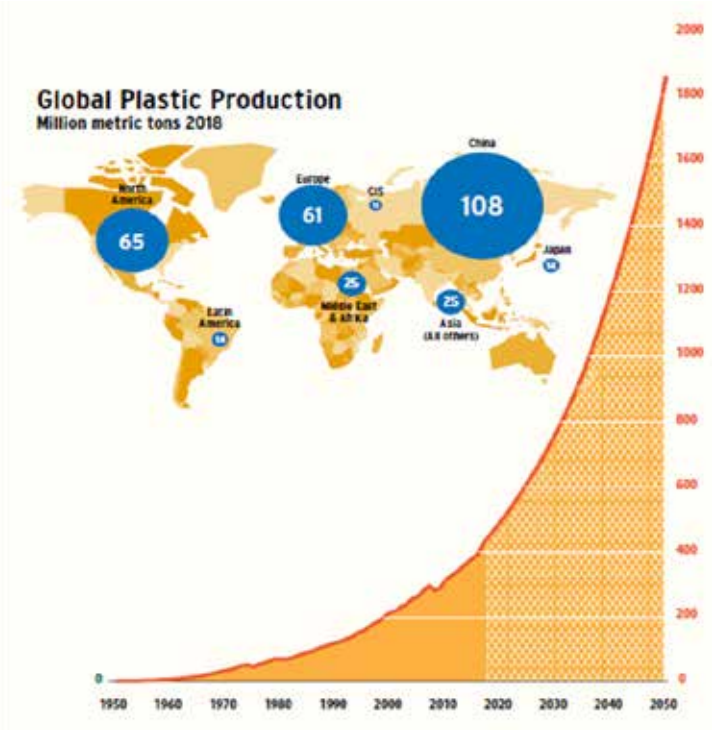


Figure 3. Predicted global plastic production increases to 2050.

tics, will be processed into RDF. As a result, a level playing field for the sustainable waste management sector is fast disappearing and recycling operations will have to compete with RDF operations. This will bring far-reaching and long-term consequences for all Australian states and territories as well as for those Asia Pacific countries importing Australia's reprocessed waste-based RDF.

Australia is one of the highest per capita generators of single-use plastic waste (see Figure 4) and this is likely to increase as the fossil fuel industry shifts its operations from fuels to petrochemicals and plastics. Massive increases in plastic goods and waste are anticipated as fossil fuel corporations move to a five-fold increase in plastic production by 2050.

The threat of global climate change and plastic waste pollution demands that we uphold internationally recognised principles of ecologically sustainable development, zero waste, a circular economy, and environmental health and justice. However, Australia's policy approach, while superficially appearing to take responsibility for recycling its waste instead of ex-

porting it, is a cynical exercise in reprocessing and repackaging the same low-grade waste for export under the guise of 'fuel' to be burned. The Australian waste export ban announcement amounts to little more than a public relations exercise to maintain waste movement out of Australia and into less wealthy countries.

This is a form of waste colonialism[5]. The term waste colonialism is often used to describe the transboundary disposal of a variety of hazardous and toxic wastes, including electronic waste, persistent organic pollutants (POPs), industrial waste, decommissioned ships, municipal solid waste, radioactive waste, and other toxic waste. The United Nations Basel Convention was among the first to acknowledge this concept. The Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal was adopted on 22 March 1989[6]. The transboundary movement of mixed plastic waste from the global north to the global south is no different given the inherent toxicity of most plastic wastes and the pollution burden it brings to the importing country.

Figure 4. Single use plastic waste generation per capita.

5 Liboiron Max, Pollution is Colonialism, Duke University Press, 2021.
6 http://www.basel.int/

Further, the recent Basel Ban Amendment supports this concept of waste colonialism by restricting the exports of any mixed or contaminated plastic wastes from the global north to the global south. The Basel Ban Amendment is an agreement taken by Basel Convention Parties to prohibit the member states of the Organization for Economic Cooperation and Development (OECD), the European Union (EU), and Liechtenstein from exporting hazardous wastes as defined by the Convention to other countries – primarily developing countries or countries with economies in transition.[7]

Australia, as an OECD country and a signatory to the Basel Convention, with one of the highest levels of plastic use per capita, has a responsibility to take a leadership role for waste management policy in this region and ensure the days of waste colonialism end once and for all. Exporting waste-derived fuels simply highlights the Australian government's recalcitrance over contemporary waste export limitations and a commitment to a linear economic model expressed through its inability to look beyond burning and burying waste — preferably in someone else's back yard.

1.2 THE GLOBAL WASTE CRISIS AND AUSTRALIA'S RESPONSE.

Recently, UN Secretary General, Antonio Guterres, described a global 'War on Nature' in his latest UNEP report, Making Peace with Nature - A scientific blueprint to tackle the climate, biodiversity and pollution emergencies.[8]

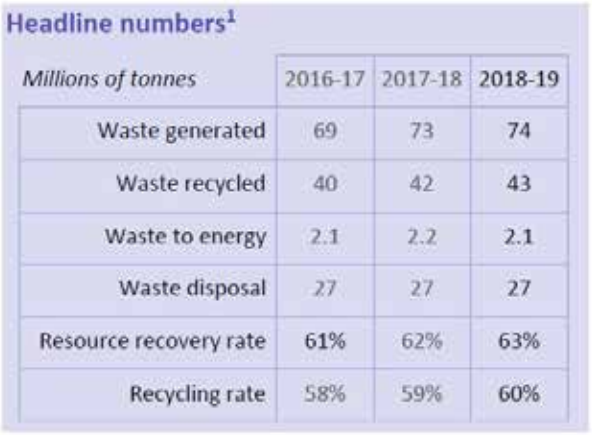
"Humanity is waging war on nature. This is senseless and suicidal. The consequences of our recklessness are already apparent in human suffering, towering economic losses and the accelerating erosion of life on Earth."

The report highlights the nexus between the global climate, biodiversity, and pollution crises and describes the toxic trail of economic growth – waste and pollution. In this 2021 report, during a global pandemic, while facing the worst climate-induced ecological catastrophes and biodiversity losses ever, the UN warns us that our human-designed systems of materials production must change urgently.

In 2016, Jiu-liang Wang debuted his ground-breaking documentary *Plastic China,* which exposed how China had become the world's largest importer of waste and the profound adverse human health, environmen-

7 http://wiki.ban.org/images/0/0b/UNEP-CHW.14-CRP.40.English.pdf

8 United Nations Environment Programme (2021). Making Peace with Nature: A scientific blueprint to tackle the climate, biodiversity and pollution emergencies. Nairobi. https://www.unep.org/resources/making-peace-nature



Headline numbers[1]

Millions of tonnes	2016-17	2017-18	2018-19
Waste generated	69	73	74
Waste recycled	40	42	43
Waste to energy	2.1	2.2	2.1
Waste disposal	27	27	27
Resource recovery rate	61%	62%	63%
Recycling rate	58%	59%	60%

Figure 5. Waste management methods in Australia. Source: Blue Environment National Waste Report 2020)

tal, and social impacts this was causing. This documentary led to China's National Sword Policy, which effectively banned the importation of any unsorted or unprocessed waste from other countries.

This wake-up call to the world exposed a previously under-acknowledged and unaddressed, waste colonialism in the form of the wealthy global north dumping its waste on the low-income global south. Following China's lead and reacting to a sharp influx of waste exports, Asia Pacific region countries quickly responded with similar waste import restrictions, while Australia declared a world first 'Waste Export Ban'.

According to UNEP and the International Solid Waste Association (ISWA), humans generate 7-10 billion tonnes[9] per annum (TPA) of waste, of which approximately 2 billion TPA is household waste[10]. Australia has very high levels of waste generation and low levels of recycling compared to its OECD counterparts and has never developed high levels of domestic recycling due to its 'export' model of recycling.

Data reported to the Australian Government in 2020 shows that Australia generates approximately 74 million TPA of waste in total, with 2.94 TPA per capita. Of this total amount of generated waste, masonry material waste was the largest category (22.9 Mt), followed by organics (14.3 Mt),

9 1 tonne = 1 metric ton; Mt = megatonne or million tonnes

10 United Nations Environment Programme, The Global Waste Management Outlook, 2015. https://www.unep.org/resources/report/global-waste-management-outlook

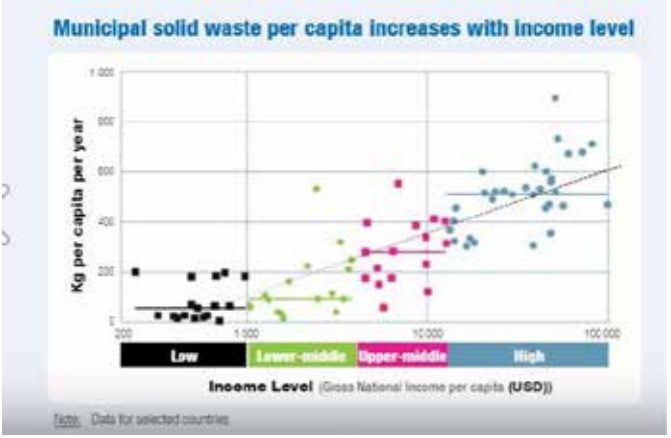


Figure 6. Waste generated, by income. Source: UNEP and ISWA Global Waste Management Outlook - Summary for Decision-Makers 2015

ash (12.5 Mt), hazardous wastes (7.8 Mt), paper and cardboard (5.9 Mt), metals (5.6 Mt), and plastic (2.5 Mt).

Australian waste generation by category shows:

- 12.6 Mt of municipal solid waste (MSW) from households and local government activities (500 kg per capita and 20% of the total)
- 21.9 Mt from commercial and industrial (C&I) sectors (36% of the total)
- 27.0 Mt from the construction and demolition (C&D) sector (44% of the total).

In comparison, citizens in developing countries with low incomes generate significantly less waste per capita (see Figure 6).

As the global population grows and moves from rural areas to urban areas, and with 32 out of 41 megacities located in developing countries with inadequate waste management services, the case for sustainable global waste management is urgent. The loss of biodiversity, the local and global pollution impacts to land, sea, and air, the adverse public health impacts, and the financial burden imposed on developing countries, caused by poor waste management have been documented for decades. As UNEP and ISWA report, "The costs to society exceed the financial costs per capita of proper waste management by a factor of 5-10."

Australia maintains a permanent delegation to the OECD and participates in the OECD South East Asia Regional Programme. As such, Australia should, as an OECD country and regional partner in the Southeast Asian region, uphold best practices for waste management at home, but also support its regional neighbours.

Australia's 'Waste Export Ban' was a political announcement made following news reports and political pressure about Australian waste exports polluting countries in the region. Now the question must be asked: Will Australia live up to its commitments or will it default to a passive business as usual approach at best, or a stealthy waste-burning approach? Was this announcement a genuine attempt to take responsibility for Australian waste or a deliberate marketing tactic to distract from plans to burn our waste in cement kilns and incinerators both in Australia and throughout Southeast Asia? This report seeks to clarify the outcomes of the export ban and the actions Australia has taken to manage its waste.

1.3 AUSTRALIA'S WASTE EXPORT BAN AND DOMESTIC 'PROCESSING'.

"It's our waste and it's our responsibility", announced the Australian Prime Minister in August 2019. This announcement was soon followed by the agreement of the Council of Australian Governments (COAG) to set a timeframe for the implementation of Australia's waste export ban.

On 9 August 2019, COAG agreed Australia should establish a timetable to ban the export of unprocessed waste plastic, paper, glass and tyres and build its capacity to generate high-value recycled commodities and associated demand.

The first piece of legislation to support the Australian waste export ban was the Recycling and Waste Reduction Bill, which came into force in December 2020.

The objectives of the Act are:

> *(a) to reduce the impact on human and environmental health of products, waste from products and waste material, including by reducing the amount of greenhouse gases emitted, energy and resources used and water consumed in connection with products, waste from products and waste material;*
>
> *(b) to realise the community and economic benefits of taking responsibility for products, waste from products and waste material;*

(c) to promote a circular economy that maximises the continued use of products and waste material over their life cycle and accounts for their environmental impacts;

(d) to contribute to Australia meeting its international obligations concerning the impact referred to in paragraph (a).

These objects are to be achieved by:

(a) regulating the export of waste material to promote its management in an environmentally sound way; and

(a) encouraging and regulating the reuse, recycling and recovery of products, waste from products and waste material in an environmentally sound way; and

(a) encouraging and regulating those responsible for using, designing, manufacturing and distributing products to take responsibility for those products, including by taking action that relates to:

(i) reducing or avoiding generating waste through improvements in product design;

(i) improving the durability, reparability and reusability of products; and

(i) managing products throughout their life cycle.

This Act complements and extends existing laws on hazardous waste and product stewardship by effectively prohibiting the export of 'unprocessed' materials collected for recycling: plastic, paper, glass, and tyres. Materials that have been re-processed and turned into other 'value-added' materials (those ready for further use) can still be exported under the law. For example, a single type of plastic (e.g. a single polymer) cleaned and shredded into 'flakes' or cleaned packaging glass crushed into 'cullet'.

The Australian government has clarified the new rules attached to the Recycling and Waste Reduction (Export – waste Plastic) Rules 2021 (Plastic Rules) in their Waste Plastic Exports list.

In addition, to support the timetable set by the Australian government to implement the Waste Export Ban, major amendments to the existing Hazardous Waste Act, which sets out Australia's Basel Convention commitments, were made through the introduction in July 2021 of the Hazardous Waste Amendment Bill. This new bill simply inserts Basel Convention Annex II wastes (waste that requires special consideration and are subject to the Prior Informed Consent procedure) directly into the Act but does not enshrine any language nor the intent and purpose of the Basel Ban Amendment to prohibit export permits.

Australia's waste export ban legislation is supported by a range of national policies and government funding.

Figure 7. Exported Australian plastic waste open burned in Indonesia 2019. Source: Ecoton and Nexus 3

Australia's waste continues to be managed by states and local governments and has never been a very sophisticated system. It has relied heavily on landfill and exports due to the lack of separate collection and source separation, recycling infrastructure and markets. Its commitment to sustainable zero waste policies is very weak, and where it does exist, is usually as a form of policy rhetoric. As Australian states align their waste policies with the National Action Plan that espouses a "zero waste to landfill" approach (as defined by the waste disposal industry sector), most states are now starting to move to isolate organics from the waste stream for composting etc and improve recyclable waste collection. Most states are also introducing container deposit schemes and banning some single-use plastics.

However, mixed waste collection continues to dominate in all Australian states and undermine the quality of recyclable materials and their potential reuse. This has partly been caused by the undue influence of the waste incineration industry in local, state and national policy development, ensuring that the generation of residual waste stockpiles continues to provide the feedstocks for waste burning. In most states, only non-recyclable waste is permitted to be incinerated, however the definition of 'non-recyclable' or 'residual' doesn't address whether it is technically possible to recycle the material but whether there is infrastructural capacity to recycle the material. If there is nowhere to recycle it, waste becomes 'non-recyclable or residual'.

There are more than 17 waste incineration projects planned or operating in Australia, burning more than 6 million TPA of residual waste.

The Australian government has recognised the need to support the recycling sector which has long struggled with inadequate capacity and even more so since China's National Sword Policy. This has resulted in massive plastic waste stockpiling and numerous waste stockpile fires occurring (particularly of plastic waste), as well as in public outrage over the dumping of recyclable waste into landfills. The lack of capacity or domestic recycling is the direct result of an 'export' model of recycling whereby Australia sends low grade waste materials overseas, often to countries with poor capacity to manage such materials – especially plastic waste.

As such, the Australian government is investing heavily in waste reprocessing infrastructure, ostensibly to support the recycling sector and generate cleaner sources of recyclable materials for use in Australia, but predominantly overseas. This is intended to maintain the continued export of Australian waste but in a "reprocessed" form.

The Australian Recycling Modernisation Fund will deliver more than AU$190 million to states to fund new and expanded recycling infrastructure. A closer assessment shows that many of these projects will process mixed waste, plastic, and tyres into Refuse-Derived Fuels for use in Australia and Southeast Asia. Public funds are being poured into waste 'reprocessing' plants around Australia.

Federal government agencies such as the Clean Energy Finance Corporation (CEFC) are also providing financial support through their AU$100 million Recycling Investment fund.

Unfortunately, this financing, meant to support investment in the recycling sector, is in fact going to fund waste incinerators in Australia. Similarly, the Australian Renewable Energy Agency has forecast an AU$5 billion bioenergy future for Australia and has already invested in numerous MSW waste incineration projects. The Product Stewardship Investment Fund has invested AU$14.5 million to support waste recycling and reprocessing infrastructure. In total, the CEFC has estimated a AU$7.8 billion investment pipeline until 2025 across Australia's waste, bioenergy, recycling, and resource recovery sectors.

Australia's waste policies, action and investment plans and partnerships are clear on one thing – massive financial support for plastic reprocessing to enable chemical recycling, waste incineration, and Refuse-Derived Fuel sectors.

2. WHAT IS REFUSE-DERIVED FUEL?

Refuse-derived fuel (RDF) is waste materials including plastic, timber, paper, and textiles (often made of plastic as well), and other high-calorific value wastes that are sorted, shredded, and either baled or pelletised to be used as fuel. In Australia, there are currently no specifications for RDF beyond reaching certain minimum calorific values required by the end user, which is usually cement kilns or incinerators. However, this type of waste fuel is also used by some pulp and paper mills and co-fired with coal in some thermal power plants. Refuse-derived fuel is also an umbrella term that includes other types of fuel that may have tighter specifications, including limits on mercury and chlorine content which can be emitted from burning operations, corrode cement kilns or reduce the quality of the cement produced.

Other names for similar products include Process Engineered Fuel (PEF), Solid Recovered Fuel (SRF), Tyre-Derived Fuel (TDF), and so on. The main characteristic of these 'fuels is that they have a high calorific value and generate significant heat when burned. Companies choose to use them instead of fossil fuels because they can claim they are renewable as they have some biogenic content (paper, shredded timber), are slightly less greenhouse gas-intensive than coal or oil, and are cheap or free to use.

Figure 8. Baled RDF in UK. Source: Circular online

Governments play along with the charade that these are clean fuels by offering carbon credits and other 'emission reduction' incentives to companies that use waste fuels. However, the impact of the toxicity of chemical additives in the plastics in RDF, the main driver of calorific value, is rarely considered.

2.1 HOW DO THEY MAKE RDF?

RDF is produced from residual waste that may or may not contain recyclable material. Most non-combustible materials such as ash, stones, soil, metal and glass are removed before the waste is processed through a series of shredders with the final material taking the form of pelletised or baled waste for shipment to the end user. Some processing units integrate the metal and stone screening processes in a semi-continuous production line (see Figure 10).

While the process diagrams and computer-assisted graphic representations of RDF factory systems appear neat and clean, the reality as shown in Figure 11 is significantly less so.

Once the bales or pellets are produced, they can be loaded into ship holds directly or packed in containers bound for their export destinations.

Figure 9. Pelletised RDF, Hungary. Source: 3E News

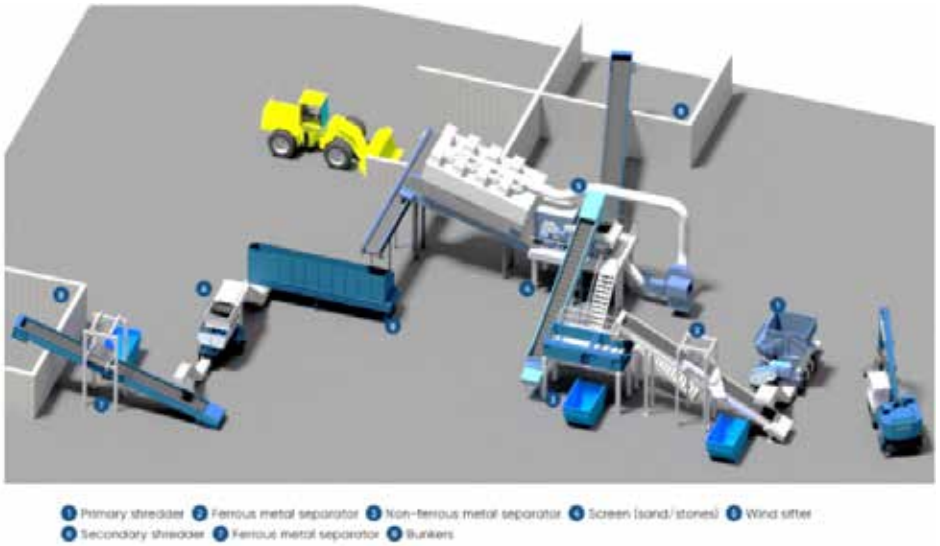


Figure 10. RDF manufacturing plant advertised layout.
Source: Andritz Group

Figure 11. RDF processing. Source: WEIMA

Figure 12. Baling and loading RDF in Ireland bound for Landskrona Energi Swedish Incinerator. Source: Geminor

2.2 RDF: A WASTE BY ANY OTHER NAME...

Refuse-Derived Fuel is a broad term[11] used to describe residual wastes, including those from the Municipal Solid Waste (MSW), Construction and Demolition (C&D), and the Commercial and Industrial (C&I) waste sectors, that are used as fuel in waste incinerators, cement kilns, industrial boilers, and co-incineration technologies like pulp mills.

Under this broad definition, wastes can also be processed into material that the waste industry has coined various terms for including Process Engineered Fuel (PEF), Solid Waste Fuel (SWF), Waste-Derived Fuel (WDF), and Solid Recovered Fuel (SRF), and usually are associated with better 'quality' and material specifications (e.g., low mercury and chlorine content) due to the manufacturing requirements specified by the customer. This usually involves more dedicated source separation and reprocessing to remove contaminants and non-combustible materials.

In Australia, since 1 July 2021, exporters will need to obtain a licence to export Processed Engineered Fuel (PEF) that includes waste plastic and meet processing requirements set out in an appropriate specification prior to export as a condition of that licence.

11 https://www.ieabioenergy.com/wp-content/uploads/2020/05/Trends-in-use-of-solid-recovered-fuels-Main-Report-Task36.pdf

Australia currently has a significant RDF manufacturing industry which is set to expand. South Australia is the main producer, exporter and user of RDF, largely due to their cement and brickworks manufacturing industry. The main company developing RDF in Australia at this point is ResourceCo which also partners with Suez, Cleanaway (in Australia), and ResourceCo Asia (Malaysia) to produce a range of waste-derived fuels. ResourceCo claims to process 2 million tonnes per annum of waste and has the capacity to produce 120,000 tonnes per annum of PEF[12].

ResourceCo and Adelaide Brighton in South Australia account for the majority of RDF production, use and export in Australia. In 2010, the South Australian EPA developed a standard[13] for RDF – Standard for the Production and Use of Refuse-Derived Fuel.

This South Australian EPA regulatory instrument is currently the only technical standard available in Australia for RDF.

Under this regulatory standard, in order for proponents to be able to obtain a licence to operate and produce RDF, they must address certain considerations to gain approval. These include:

Support for the Waste Hierarchy. The project must avoid and minimise waste, and maximise reuse and recycling through dedicated source separation, ensuring higher order uses of the waste ahead of energy recovery through combustion, while ensuring that any proposal for combustion of RDF is for energy recovery and not waste disposal.

An immediate market. There must be an immediate market for the RDF that ensures wastes are not cannibalised from higher order uses and that material flows are stable to avoid and reduce stockpiling.

Risk-based approach. A robust precautionary approach to risk assessment for both the production and combustion of RDF, is a key requirement.

Prevention and minimised potential for harm. The proposal must not cause harm to human health and the environment nor increase emissions or risk of harm as a supplement or replacement for fossil fuels or other standard commercial fuel sources.

Demonstration of beneficial purposes. The project must demonstrate an acceptable and genuine benefit that does not involve waste disposal via incineration, that demonstrates that the RDF has valuable calorific value

12 https://resourceco.com.au/what-we-do/energy/
13 https://www.epa.sa.gov.au/files/4771351_standard_rdf.pdf

that does not displace higher order uses or entrench waste disposal via incineration and ensures the project is a genuine replacement of fossil fuels and other standard commercial fuels.

No dilution of waste or chemical substances. Ensure the components of RDF are suitable and meet the required specifications for use, excluding any dilution of waste and chemicals in the process for the purpose of achieving cheaper waste disposal.

A consistent approach to regulation. All cross-sector regulatory approvals must be received prior to operation including health, environmental, and planning, including adequate and fit for purpose community consultation. The production and combustion of RDF must not result in a convenient and cheap way to avoid regulation or dispose of waste.

Under this standard there is also a list of prohibited wastes that must not be used. These include:

- Asbestos
- Copper Chrome Arsenic (CCA) treated timber
- Hazardous waste
- Wastes with high mineral content
- Medical waste
- Radioactive waste
- Quarantine and biosecurity material
- Schedule wastes
- Wastes that have a higher order value in the waste hierarchy
- Waste treated by immobilisation or containerisation

The South Australian regulators state that the key to complying with this standard is demonstrated regard for the inputs and outputs of the RDF including:

Inputs: Producing a consistent product is vital to ensure combustion is efficient and effective and fit for purpose at the RDF production facility, that the expected emissions are known and able to be effectively monitored for compliance with environmental and health regulations, and that the process does not produce a product that is variable and unpredictable.

Outputs: The outputs are directly related to the inputs, the combustion technology used and all associated regulatory compliance systems. This is a critical consideration for any RDF production to prevent harm throughout the full life cycle of RDF production and use. Such consideration

Figure 13. Location of Resource Co facilities and export plans in the AP region. Source: ResourceCo

influences the design and implementation of the pollution controls and monitoring systems used in the combustion technology and can provide critical information on emissions of concern, and other plant performance and regulatory compliance needs.

These standards set by the South Australian government apply to the production of RDF in South Australian ResourceCo facilities, which dominate the Australian market for RDF production. As can be seen in Figure 13, ResourceCo's RDF and Tyre-Derived Fuel is destined for a number of Southeast Asian countries, where they have existing and operating ResourceCo facilities.

The extent of Australia's waste-based fuel export ambitions is revealed in a company-supplied graphic from ResourceCO, showing their current and planned markets throughout southeast Asia.[14]

While Australia is gearing up for large-scale exports of RDF, both China and India have also started to develop RDF industries and have increasing demands for RDF imports. The movement of RDF in Figure 13 shows significant exports from Malaysia to India and from Indonesia to China. Thailand exports SRF to China, India, Malaysia, and Indonesia. Australian Tyre-Derived Fuel is exported to Japan, Malaysia, and Korea, while the bulk of PEF is exported to cement kilns in the Philippines.

14 https://resourceco.com.au/app/uploads/2020/02/CD4675_RC-Asia_A4-3pp_AboutUs_CMYK_%C6%92_WEB.pdf

Figure 14. Transboundary shipment of RDF (red line) and SRF (blue line) in Asia. Source: IEA 2020

Authorities in the Philippines have previously rejected Australian PEF shipments as waste dumping with the material claimed to be indistinguishable from municipal solid waste. John Simon, a customs inspector at Mindanao International Container Terminal, raised the alarm about the Australian PEF shipment. "That's why there is an apparent violation as far as Customs law is concerned. The question is, are they the same? They insist it is. But I beg to disagree because garbage is garbage, fuel is fuel."

Presidential Spokesperson Salvador Panelo said, "We will not allow ourselves to be dumping ground of trash. That is our stance. It will be offensive to this government, to be the recipient of trash or basura. We are offended by that; we will not allow it. We will send them back. In the first place, how did they even get in?"[15]

As the economies in China and India expand, these countries are moving to align their RDF industry standards with accepted international standards to further enable imports, opening up more trade opportunities for countries like Australia, who are waiting in the wings ready to take up such opportunities.[16]

15 https://cnnphilippines.com/news/2019/5/23/denr-emb-customs-fuel-holcim-australia-mismis-oriental.html

16 P31, IEA, Trends in the use of solid recovered fuel, IEA Bioenergy, 2020.

Figure 15. Philippine's customs officers raid PEF shipment from Australia 2019. Source: CNN Philippines

2.3 CHARACTERISATION AND TOXICITY OF RDF

RDF and SRF Profile in Europe

The profile and toxicity of RDF and SRF production in other countries varies and again depends on the end use. However, it is clear when comparing European standards to Australian, that the specifications for the manufacturing of RDF's are more clearly defined and regulated. Burning plastic waste can lead to highly toxic emissions. Plastics containing halogenated chlorine, bromine and fluorinated additives can generate brominated and chlorinated dioxins and PFAS substances as emissions and in solid waste residues.

According to the International Energy Agency Bioenergy[17] in Italy, SRF headed for combustion in a coal power plant meets the specifications in the following table:

17 International Energy Agency Bioenergy, Trends in the solid recovery of fuel, 2020, https://www.iea-bioenergy.com/wp-content/uploads/2020/05/Trends-in-use-of-solid-recovered-fuels-Main-Report-Task36.pdf

TABLE 1. SRF QUALITY REQUIREMENTS SET IN A SPECIFICATION AGREED UPON PRODUER AND END USER (COAL POWER PLANT, 2016 ITALY) - REQUIRED CLASS OF SRF: 3:3:3.

Parameter	Unit	Typical Value	Limit Value
Ash	%, d	≤20	≤20
Moisture	%, ar	≤15	≤15
NCV	MJ/kg, ar	value set in table 1 of 15539 for the requied class code	value set in table 1 of 15539 for the requied class code
NCV	MJ/kg, d	≤15	≤15
Cl	%, d	value set in table 1 of 15539 for the requied class code	value set in table 1 of 15539 for the requied class code
Sb	mg/kg, d	≤70	≤150
As	mg/kg, d	≤9	≤15
Cd	mg/kg, d	≤7	≤10
Cr	mg/kg, d	≤100	≤500
Co	mg/kg, d	≤7.5	≤100
Cu	mg/kg, d	≤1300	≤2000
Pb	mg/kg, d	≤200	≤600
Mn	mg/kg, d	≤400	≤600
Hg	mg/kg, d	value set in table 1 of 15539 for the requied class code	value set in table 1 of 15539 for the requied class code
Ni	mg/kg, d	≤40	≤200
Tl	mg/kg, d	≤1	≤10
V	mg/kg, d	≤7.5	≤150
∑ Heavy metals	mg/kg, d	to be declared	to be declared

ar: as received; d: dry basis; Data from personal communication of an Italian SRF end user. This agreed specification requires that SRF complies with UNI EN 15539 and the Italian UNI TR 11581 (a) Sum of heavy metals does not include Hg, Tl and Cd according to EN 15539:2011

Source: International Energy Agency 2020

SRF used in a co-combustion power plants and cement kilns in Italy.

TABLE 2. SRF QUALITY REQUIREMENTS SET IN A SPECIFICATION AGREED UPON PRODUCER AND END USERS (CO-COMBUSTION POWER PLANTS AND CEMENT KILNS, 2016, ITALY).

		Limit values	
Parameter	**Unit**	**Min**	**Max**
Ash	%, d	15	30
Moisture	%, ar	10	30
NCV	kcal/kg, ar	3583	9500
Cl	%, d	0.6	1.5
S	%, d	0.3	0.8
Pb (volatile)	mg/kg, d	100	200
Cr	mg/kg, d	70	833
Cu (soluble)	mg/kg, d	300	500
Mn	mg/kg, d	217	500
Ni	mg/kg, d	40	333
As	mg/kg, d	9	15
PCB	mg/kg, d	0.5	30
Zn	mg/kg, d	500	1000
Co	mg/kg, d	67	100
Cd	mg/kg, d	27	33
Sn	mg/kg, d	70	100
Sb	mg/kg, d	20	267
Hg	mg/kg, d	1.0	1.7
Tl	mg/kg, d	3.3	10
V	mg/kg, d	20	100
Cn	mg/kg, d	2	2
F	mg/kg, d	1000	1000
Be	mg/kg, d	50	50
Ba	mg/kg, d	200	200
Se	mg/kg, d	5	5
Te	mg/kg, d	10	10

ar: as received; d: dry basis; Data from personal communication of an Italian SRF end user.

Source: International Energy Agency 2020

TABLE 3. SRF QUALITY REQUIREMENTS SET IN A SPECIFICATION AGREED UPON PRODUCER AND END USER (CEMENT INDUSTRY, 2016, ITALY).

Parameter	Unit	Limit value
NCV	GJ/t, ar	≥15
Cl	%, d	1
S	%, d	-
Hg	mg/kg, d	1
As	mg/kg, d	5
Cd	mg/kg, d	3
Cr	mg/kg, d	100
Cu	mg/kg, d	500
Pb	mg/kg, d	240
Mn	mg/kg, d	250
Ni	mg/kg, d	30
Tl	mg/kg, d	1
Co	mg/kg, d	18
Sb	mg/kg, d	50
V	mg/kg, d	10
IPA (total)	mg/kg, d	30
PCB	mg/kg, d	3
PCDD/PCDF	ng TE/kg, d	20

ar: as received; d: dry basis; TE: total concentration. Data from personal communication of an Italian SRF end user.

Source: International Energy Agency 2020

Example of RDF specifications used in a German Cement Kiln:

TABLE 4. TYPICAL END-USER DEMANDS APPLIED (2006) IN GERMAN CEMENT KILNS.

	Range of typical concentrations (a)		Typical concentrations (b)	
Key Parameter	**Unit**	**Values**	**Unit**	**Values**
Pb	mg/MJ	0.09 - 25	mg/kg, d	400
Cd	mg/MJ	0.01 - 0.7	mg/kg, d	9
Cr	mg/MJ	0.09 - 21	mg/kg, d	250
Ni	mg/MJ	0.1 - 25	mg/kg, d	100
Hg	mg/MJ	0.01 - 0.1	mg/kg, d	0.5 – 1
Tl	mg/MJ	<0.01 - 0.1	mg/kg, d	1 - 2
Zn			mg/kg, d	-
As			mg/kg, d	13
Co			mg/kg, d	12
Cu			mg/kg, d	700
Mn			mg/kg, d	500
Sb			mg/kg, d	120
V			mg/kg, d	25
Sn			mg/kg, d	70

d: dry basis. (a) VDI 2094 Germany (2003). "Emissionsminderung Zementwerke/Emission control cement indusry, VDI 2094, 2003; (b) Germany, V. (2006). "Cement manufacturing industries, German contribution.

Source: IEA 2020, p. 22, Schorcht et al. 2013

Japan has set standards for waste-derived fuels:

TABLE 5. CLASSIFICATION SYSTEM AND FUEL QUALITY REQUIREMENTS SET IN THE JAPANESE STANDARD JIS Z 7311 FOR WASTE-DERIVED FUELS NAMED RPF (REFUSE DERIVED PAPER AND PLASTICS DENSIFIED FUEL) AND RPF-COKE (RPF WITH COKE-LEVEL GROSS CALORIFIC VALUE).

Key Parameter	Value (mean) RPF-coke	Value (mean) RPF Class A	Value (mean) RPF Class B	Value (mean) RPF Class C	Unit	Boundary (End-uses)
NCV	≥33	≥25	≥25	≥25	MJ/kg, ar	Coal co-combustion (cement kiln, power plants) Incineration Co-incineration
Moisture	≤3	≤5	≤5	≤5	%, ar	
Ash	≤5	≤10	≤10	≤10	%, d	
Cl (residual)	≤0.6	≤0.3	>0.3-≤0.6	>0.6-≤2.0	%, ar	

ar: as recieved; d: dry basis.

Source: IEA 2020

Thailand identifies a range of RDF types that have been adopted from the American Standards for Testing Materials.

TABLE 6. THAILAND REGULATIONS FOR SRF/RDF.

RDF-1	Waste used as fuel in as-discarded form
RDF-2	Waste processed to coarse particle size, with or without ferrous metal separation.
RDF-3	Shredded fuel derived from MSW that has been processed to remove metals, glass, and other inorganic materials (95%wt., passes 50mm^2 10 mesh)
RDF-4	Combustible waste processed into powder form (95%wt., passes 50mm 10 mesh)
RDF-5	Combustible waste densified (compressed) into a form of pellets, slugs, briquettes, or briquettes (d-RDF)
RDF-6	Combustible waste processed into liquid fuel
RDF-7	Combustible waste processed into liquid, gaseous fuel

Soure: IEA 2020

India has some standards for waste fuels used in cement kilns:

TABLE 7. CLASSIFICATION CRITERIA AND LIMIT VALUES (MEAN) FOR WASTE FUELS UTILISED IN CEMENT KILNS PROPOSED (2018) IN INDIA BY THE EXPERT COMMITTEE APPOINTED BY THE NATIONAL MINISTRY OF HOUSING AND URBAN AFFAIRS (MOHUA).

Key Parameter	SCF Limit Value	RDF Grade III Limit Value	RDF Grade II Limit Value	RDF Grade I Limit Value	Unit	Boundary (End-uses)
NCV	>1500	>3000	>3750	>4500	kcal/kg	Coal co-combustion (cement kiln)
Ash	<20	<15	<10	<10	%	
Moisture	<35	<20	<15	<10	%	
Cl	<1.0	<1.0	<0.7	<0.5	%	
Particle size	<1.5	<50, if ILC plant (a) <20, if SLC plant (b)			mm	

(a) ILC: In Line Calciner; (b) SLC: Separate Line Calciner

Source: IEA 2020

Despite expansion of the production and use of waste-derived fuels globally as outlined by the International Energy Agency, it is clear that there are no internationally aligned and agreed standards for the production, use, trade, and disposal of waste-derived fuels. Does this reflect a business as usual approach for the industrial (and fossil) fuel sector? How will the human rights and environmental justice of vulnerable countries in the global south already heavily burdened with waste, chemicals, and pollution impacts be protected from the externalities of this burgeoning new fuel industry?

2.4 ENVIRONMENTAL IMPACTS OF PEF

Burning Process Engineered Fuel in cement kilns and other industrial combustion chambers comes with significant environmental impacts.

These include emissions of greenhouse gases, toxic metals, VOCs, chlorinated and brominated dioxins, PCBs, PAHs, particulates, and a range of hazardous emissions that are associated with burning plastic – fossil fuel.

TABLE 8. INCREASE IN CARCINOGENIC EMISSIONS USING RDF FROM A CEMENT KILN.

		Individual Measurements		
Parameter	**Unit**	**No use of wastes**	**Use of wastes**	**Change**
Total Particulate	mg/m³	2.8 - 12.90	12.0 - 15.900	Increase
HCl	mg/m³	0.88 - 5.93	0.87 - 1.320	Decrease
SOx	mg/m³	714 - 878.00	311 - 328.000	Decrease
HF	mg/m³	0.13 - 0.23	0.02 - 0.040	Decrease
NOx	mg/m³	789 - 835.00	406 - 560.000	Decrease
Total Carbon	mg/m³	11.7 - 23.20	5.7 - 7.100	Decrease
Polycyclic aromatic hydrocarbon	mg/m³	-	0.003	Increase
Benzene	mg/m³	0.27 - 0.540	0.45 - 0.550	Increase
Cd	mg/m³	<0.005	<0.007	Increase
Tl	mg/m³	<0.005	<0.005	No change
Hg	mg/m³	0.014 - 0.044	0.003 - 0.006	Decrease
Sum of Sb, As, Pb, Cr, Co, Cu, Mn, Ni, V, Sn	mg/m³	<0.300	<0.500	Increase
PCDD/PCDF, I-TEQ	mg/m³	0.001 - 0.002	0.005 - 0.006	Increase

Adapted from Hasanbeigi et al.

Source: Pembina Institute and Environmental Defence 2014

According to industry data and a Zero Waste Europe[18] analysis of RDF, it is regularly comprised of: 31% plastic, 30% unknown, 13% paper, 14% textiles, and 12% wood.

While the waste incinerator sector is required to meet strict operational and emissions standards, these same regulatory requirements are not required for the cement industry sector. This means more pollution per kg of fuel burnt is released from cement kilns compared to waste incinerators. In particular, the exhaust gas flow rate is higher for cement kilns than waste incinerators, which is a major contributing factor to the higher pollution levels emitted by cement kilns. According to US industry com-

18 M Vilella, Why Co-incineration of waste is not taxonomy compliant and should be excluded, Zero Waste Europe, 2020.

pliance data, for each tonne of waste burned in a cement kiln, the exhaust gas flow rate is 5-10 times higher than in a waste incinerator. This means that each pollutant released from cement kilns is 7 times higher compared to a waste incinerator.[19]

The table below shows the volume of the emissions from a cement kiln burning RDF and increases over standard fossil fuels of carcinogenic emissions such as PAHs, benzene, dioxin, cadmium, and other heavy metals.

2.5 HEALTH IMPACTS OF RDF

The use of RDF and PEF in waste incinerators and cement kilns generates similar emissions as burning waste. The heterogenous nature of waste means that each load of RDF or PEF entering a combustion chamber can contain different quantities, types, and concentrations of toxic substances. High volumes of PVC plastic in PEF for example can increase the generation of dangerous Persistent Organic Pollutants (POPs) such as dioxins and furans. Plastic or wastes containing perfluorinated chemicals often used as flame retardants, can generate PFAS chemicals. These toxic substances are emitted via the stack and also enter the ash waste stream in incinerators. In cement kilns they can be emitted from the stack and entrained in the cement product causing exposure issues for construction workers. POPs are known to be associated with a range of serious chronic and acute health impacts, including cancer. Their persistent, bioaccumulative, and transboundary properties have caused them to be listed under the Stockholm Convention for elimination and global control.

In addition, many toxic metals such as chromium, lead and mercury are known to be emitted from waste incinerators and cement kilns burning RDF along with carcinogenic PAHs and benzene. Respiratory and cardiovascular impacts are correlated directly with increased particulate emissions, which grow when RDF is burned.

Micro- and nanoparticles, which are known to be associated[20] with waste incineration of all types, have no safe exposure standard and can transfer directly into the blood and organs of the human body due to their size. Whether directly emitted via the stack or through exposure to ash, micro- and nanoparticles harm human health. When considering the health impacts of burning RDF in correlation with waste incineration, it is imperative to look at existing peer-reviewed and published evidence such as the meta-analysis and international systemic review undertaken by The Australian Public Health Association. This relatively conservative review

19 EW Kleppinger, Folly or Redemption: Can cement kilns really do the job? 1993

20 Holder, Amara & Vejerano, Eric & Zhou, Xinzhe & Marr, Linsey. (2013). Nanomaterial disposal by incineration. Environmental science. Processes & impacts. 15. 10.1039/c3em00224a.

warns that, "This systematic review highlights significant risks associated with waste incineration as a form of waste management. Many older incinerators were linked with neoplasia, reproductive issues and other diseases. While the results were not consistent across the literature, based on a precautionary principle there is insufficient evidence to conclude that any incinerator is safe. There is some suggestion that newer incinerator technologies with robust maintenance schedules may be less harmful, but diseases from exposures tend to manifest only after many years of cumulative exposure, so it is premature to conclude that these newer technologies improve safety."[21]

In Western Australia, Cockburn Cement (a subsidiary of Adelaide Brighton) has been at the centre of protests by local residents for many years, as dust and fumes from the facility damage roofs and cars, and are alleged to harm local residents' respiratory health, with legal cases pending. Adelaide Brighton has plans to increase the use of RDF as an alternative fuel in Australia[22].

21 Peter W.Tait et al, (2019), The Health Impacts of Waste Incineration: a systemic review. Australian and New Zealand Journal of Public Health 2020 vol. 44 no. 1.

22 https://adelaidebrightoncommunity.com.au/alternative-fuels-and-raw-materials/kiln-refused-derived-fuel/

Figure 16. Cockburn Cement Western Australia.

Figure 17. Residents protest Cockburn Cement emissions.
Source: Roel Loopers

3. AUSTRALIAN PLASTIC WASTE EXPORTS

Following the Australian Governments Waste Export Ban, the import and export of plastic waste is required to be in accordance with this new legislation implemented in two phases.

The two phases of the ban are:

1. From 1 July 2021, waste plastic will need to be sorted into a single resin or polymer type before export; and
2. From 1 July 2022, waste plastic will need to be further processed, for example into flakes or pellets, before export.

From 1 July 2021, processed engineered fuel that includes waste plastic will also need to meet certain requirements before export.

In 2018–19, 191,000 tonnes (48%) of the recovered waste plastics were exported.[23] This data is collected annually and reported to the Federal Government. The latest data is shown in Table 9.

Missing from the above table are exact figures on exports of RDF and PEF, which contain significant quantities of mixed waste plastic. In 2020, more than 558 tonnes of RDF were exported from Australia.[24]

Australian plastic waste is exported under two UN Harmonised System codes. 3915 – Waste, plastic scrap and 3825 – Residual products of the chemical and allied industries, residual waste, sewage sludge and other residual products.

While these figures appear low, whether they are a true reflection of the actual quantities of waste-derived fuels being exported from Australia, is unknown. Industry and Government bodies recognise that these codes are insufficient to accurately record the real volumes of waste-derived fuels being exported from Australia, as the submissions to the Australia government outline below. For example, the following table highlights their

23 2018-19 Australian Plastics Recycling Survey (2020) Envisage Works for the Department of Agriculture, Water and the Environment.

24 MRA Consulting Group, Waste Plastics Industry Standards, Submissions to the Department of Agriculture, Water and Environment, March 2021

TABLE 9. EXPORT TONNES AND COMMON PRODUCT FORMS BY PLASTIC POLYMER TYPES (2017-18).

Polymer Number & Name	Recovery Rate	Tonnes reprocessed and recycled locally	Tonnes exported not reprocessed	Tonnes exported reprocessed	Common product form (source)
1 PET	21%	20000	55800	600	Bottles (CDS, MRF)[a], Packaging (CDS/MRF)[a]
2 HDPE	20%	51000	52400	25500	Milk jugs (MRF)[a], Packaging (CDS/MRF)[a], Construction material[c]
3 PVC	2%	5600	900	1500	Packaging (MRF)[a], Piping[c], Medical products[a], Vinyl flooring[a,b]
4 LDPE/LLDPE	17%	33400	14000	13400	Film[c,a]
5 PP	9%	24400	18500	1900	Packaging (MRF)[a], Plant pots and crates[a], Bbuilding material[c]
6 PS	12%	2000	6000	900	PS rigid packaging (MRF)
6 EPS	12%	1500	3200	1900	EPS packaging
7 Other plastic	1%	700	2400	0	Variable
ABS/SAN/ ASA	8%	800	5900	200	Vehicles, Electrical devices, Packaging
Polyure-thanes	9%	6900	0	600	Vehicles, Building materials: insulation and carpet underlay
Nylons (polyamides)	7%	100	8400	200	Clothing, Carpet, Vehicles, Building material
Unknown polymer	7%	5000	23200	5000	Variable
Total	12%	151300	190700	51800	

(a) Post-consumer; (b) Pre-consumer; (c) Post-industrial

Source: MRA Consulting Group, Waste Plastics Industry Standards, Submissions to the Department of Agriculture, Water and Environment, March 2021

TABLE 10. AUSTRALIAN EXPORTS AND IMPORTS OF PLASTIC WASTE AND OTHER RESIDUALS PRODUCTS (UN HARMONISED SYSTEM CODES 3915 AND 3825) IN 2020

Trade Flow	Code	Trade Value (US$)	Netweight (kg)
Import	3825	$228334	558087 (est.)
Export	3825	$736768	n.d.
Import	3915	$5000228	n.d.
Export	3915	$21341895	100204278

Source: UN Comtrade Database

TABLE 11. SCRAP PLASTICS CLASSIFIED UNDER EACH HS 3915 TARIFF CODE

Harmonised system (HS) tariff code	Overview of scrap plastics generally classified to each code
39151000 Waste, parings and scrap, of plastics — Of polymers of ethylene	No consistent classifications for exported polymers with inconsistent use of descriptors by local exporters and their freight forwarders, however, probably primarily consists of sorted HDPE packaging from municipal sources (e.g., milk bottles) and LDPE/LLDPE film packaging from C&I sources (e.g., pallet wrap). May contain sorted PET bottles, even though PET is a polyester and not a polyethylene group plastic.
39152000 Waste, parings and scrap, of plastics — Of polymers of styrene	No consistent classifications for exported polymers with inconsistent use of descriptors by local exporters and their freight forwarders, however, probably primarily consists of sorted PS (from MSW sources) and EPS packaging (from C&I sources).
39153000 Waste, parings and scrap, of plastics — Of polymers of vinyl chloride	Only very low quantities exported, but probably primarily consists of post-industrial scrap from PVC product manufacturers (C&I sources)
39159092 Waste, parings and scrap, of plastics — Of other plastics	No consistent classifications for exported polymers with inconsistent use of descriptors by local exporters and their freight forwarders, however, probably primarily consists of mixed plastics packaging, across PET, HDPE, PVC, LDPE, PP and PS from MSW sources. Also may include some disassembled and sorted e-waste plastics exports recovered (primarily) through the National TV and Computer Recycling Scheme (NTCRS).

Source: Envisage Australia, Plastics Infrastructure Analysis Update, 2019.

analysis of the inconsistencies in definitions, classifications and data gaps that currently exist around the trade in waste-derived fuels for Australia. Without a globally harmonised system for the trade of waste-derived fuels, it is not possible to adequately track or assess the global impacts of using RDF and other waste-derived fuels on human health and the environment. It suggests that the current system is not fit for purpose when it comes to the global trade of RDF and waste-derived fuels. This raises serious health, environmental and human rights issues, especially for importing countries in the global south.

187 kt of scrap plastics were exported from Australia across the four 3915 export codes during 2018–19. These exports were mostly sent to the following countries:

- Indonesia received 63 kt (34% of exports)
- Malaysia received 55 kt (30% of exports)
- Philippines received 17 kt (9% of exports)
- Thailand received 11 kt (6% of exports)
- Taiwan received 11 kt (6% of exports)
- China received (only) 10 kt (5% of exports).

3.1 INVESTMENT IN AUSTRALIAN RDF AND EXPORT TO SOUTHEAST ASIA

The Australian Clean Energy Finance Corporation (CEFC) recently estimated a national finance pipeline of up to $7.8 billion in new investments in resource recovery, bioenergy and WTE until 2025. They claim that employment benefits of up to 9 000 construction jobs, 2 600 indirect jobs and as many as 1 400 direct and ongoing jobs will be delivered from these investments, and the potential across those categories is to reduce landfill emissions by as much as 60 per cent.

Industry is heavily talking up the build-out of the RDF sector in Australia, with many infrastructure projects in the pipeline.

The Australian government is investing heavily in reprocessing infrastructure in all Australian states to provide the feedstock for RDF production and use both in Australia and overseas. Government, industry and research organisations are working collaboratively to ensure that RDF, and particularly PEF, remains a key component of Australia's waste hierarchy and definition of a circular economy.

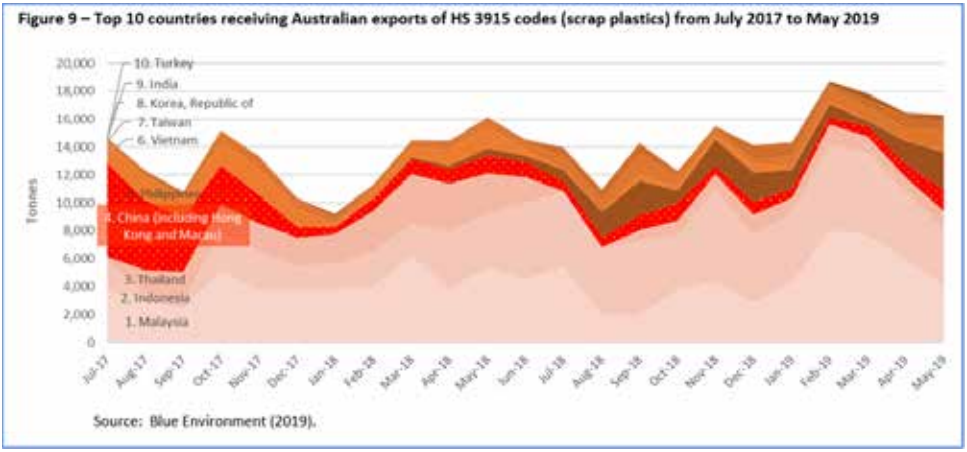


Figure 18. Top 10 countries receiving Australian export of HS 3915 July 2017 - May 2019. Source: Envisage Australia, Plastics Infrastructure Analysis Update, 2019

Australia's investment in plastic reprocessing and RDF production extends also into Southeast Asian countries like Indonesia, Malaysia and the Philippines.

3.2 NEW AUSTRALIAN REGULATIONS FOR RDF AND PLASTIC WASTE EXPORT.

On 16 December 2020, the Recycling and Waste Reduction Act 2020 (RAWR Act) came into effect, repealing and replacing the Product Stewardship Act.[25]

The rules stipulated by the new Recycling and Waste Reduction Act (The Waste Export Ban Bill), define Process Engineered Fuel in Part 2, Exporting Waste Plastic. The Act states:

> *Waste plastic is regulated waste material.*
>
> *(1) For the purposes of subsection 17(1) of the Act, waste plastic is prescribed. Note: Waste plastic that is prescribed under this section is regulated waste plastic.*
>
> *(2) Waste plastic means: (a) plastic that is discarded, rejected or left over from an industrial, commercial, domestic or other activity; or (b) plastic that is surplus to or a by-product of an*

25 Australian Government, Recycling and Waste Reduction (Export—Waste Plastic) Rules 2021, .

industrial, commercial, domestic or other activity; or (c) processed engineered fuel.

(3) Processed engineered fuel means waste material that: (a) is waste plastic within the meaning of paragraph (2)(a) or (b) that is processed with any other waste material; and (b) is intended for use as fuel.

Following industry engagement and in line with the new federal legislation, the exact specifications for Process Engineered Fuel, will be confirmed in the granting of a waste plastic export licence.

The proposed new legislation defines this:

9. Matters to which the Minister must have regard in deciding whether to grant a waste plastic export licence—processed engineered fuel:

(1) For the purposes of paragraph 34(2)(f) of the Act, this section prescribes matters to which the Minister must have regard in deciding whether to grant a waste plastic export licence in relation to regulated waste plastic that:

(a) is processed engineered fuel; and (b) is not hazardous waste (see section 10).

(2) The matters are the following:

(a) the intended use of the plastic in the place to which the plastic is intended to be exported;

(b) whether the nominated specification for the plastic is appropriate for the intended use of the plastic in the place to which the plastic is intended to be exported;

(c) if the nominated specification is not a listed waste plastic specification: (i) any calorific value requirements in the specification; and (ii) the thresholds for contaminants in the specification; and (iii) any packaging requirements in the specification; and (iv) any particle size or bulk density requirements in the specification; and (v) the thresholds for moisture in the specification; and (vi) any testing or sampling requirements in the specification.

Note: Other matters to which the Minister must have regard are specified in paragraphs 34(2)(a) to (e) of the Act. The Minister

may also have regard to any other matter that the Minister considers relevant (see subsection 34(3) of the Act)."

3.3 THE BASEL CONVENTION BAN AMENDMENT

Australia has missed a unique opportunity to ratify the Basel Ban Amendment with the Federal Government passing the Hazardous Waste Amendment Bill on 24th June 2021 without the inclusion of any reference to the new Basel Ban Amendment. There is no language in this new Act specifically acknowledging or aligning the purpose and intent of the Basel Ban Amendment into Australian law. This is despite the considerable Australian government's focus and legislative reforms on banning waste exports, overhauling Australia's waste recycling and infrastructure policy and funding multi-billion-dollar plastic reprocessing facilities designed specifically to process plastic waste for trade and export.

Instead, the Australian government continues to hide behind the old version of the Basel Convention (minus the 2019 Ban Amendment), as they are required to being a signatory to this international convention and as an OECD member. The Australian government argues that there is no need to ratify the Basel Ban Amendment because Annex II wastes of the Basel convention are already listed as hazardous in our legislation. They wilfully ignore the critical purpose and intent of the Basel Ban Amendment - to prohibit any exports of hazardous waste from wealthy countries to developing countries. They seem to be of the view that Prior Informed Consent (PIC) of the importing country is sufficient to allow export - unlike the vast majority of Basel Convention Parties who agree a total ban is required for the export of such wastes from OECD to low- income countries.

The new Hazardous Waste Act of 2021 continues to enshrine and refer to an export permit system putting this legislation in direct contradiction with the Basel Ban Amendment, which prohibits such exports, even with prior informed consent. Australia's decision to exclude the Basel Ban Amendment from its National Legislation is provocative.

"It is tantamount to saying, "We wish to retain the option of exporting hazardous wastes to developing countries, even when the Basel Convention, which we are party to, has been changed to forbid this type of trade." [26]

26 Basel Action Network and the IPEN, The Entry into Force of the Basel Ban Amendment, A guide to implications and next steps, November 2019

Australian top national environmental health and justice NGOs[27] wrote to the Australian Federal Minister and regulatory agencies in 2019 to urge Australia to immediately ratify the Basel Ban Amendment. In their correspondence they stated:

> *"Given the ambitious timeframes that state ministers have agreed to in relation to the waste export ban, we therefore request that the Australian government immediately ratifies the Basel Ban Amendment and further, that the federal government includes Basel Annex II listed wastes in the Basel Ban implementation language, as the EU has done.*
>
> *Australia's ratification of the Basel Ban Amendment and the inclusion of Annex II wastes into the Amendment implementation language would be consistent with the decision to ban waste exports and demonstrate that the Australian government cares about the health and environment of not only Australians but of citizens in those countries we trade with.*
>
> *Further that,*
>
> *To strengthen these progressive waste trade policy decisions, there is an urgent need to protect against further, potential negative externalities and to ensure a level playing field for a true circular economy. This requires Australia to uphold its commitment to the Basel Convention by ratifying the Basel Ban Amendment with the inclusion of Annex II wastes and issuing mirror legislation Federally and across the states including through regulations. The inclusion of Annex II wastes into our Basel Ban ratification would in effect strengthen our own national environmental laws and those of our trading partners and neighbours in the South-East Asian region"*

In response to this correspondence on 20 December 2019, the Australian government advised that:

> *"As you are aware the Council of Australian Governments (COAG) has agreed to a timetable to ban the export of waste plastic, paper, glass and tyres that have not been processed into value added material. This reflects the concerns of COAG about the plastic pollution in our oceans and that plastic waste does not cause harm to human health or the environment.*

27 The National Toxics Network, Climate and Health Alliance, Boomerang Alliance, The Total Environment Centre and Friends of the Earth Australia.

You may also be aware that under the Hazardous Waste (Regulation of Exports and Imports) Act (the Act) that wastes listed in Annex II of the Basel Convention are already classified as hazardous waste. The Act regulates the movement of hazardous wastes to ensure that they are disposed of safely.

Australia's position is that hazardous waste should not be exported if the receiving country does not have a suitable facility to manage waste in an environmentally sound manner. Any export of hazardous waste requires the prior informed consent of all countries involved to ensure that it will be managed in a manner that will protect human health and the environment

against any adverse effects. Australia supports the opportunity for countries to develop and utilise world class facilities that can handle hazardous wastes appropriately. This can provide important economic and environmental benefits to all countries involved in the movement and management of hazardous waste."

International criticism of Australia as a signatory flouting the intent of the Basel Convention, has been noted since at least 1999.

"In addition to the 'free rider' problem, 'a state that agrees to a treaty must execute it in good faith.' In order to execute a treaty in good faith, a ratifying state must affirmatively work to advance the spirit of the treaty. By stalling ratification of the Ban Amendment, a necessary and integral part of the Basel Convention, Australia is violating its duty of good faith by failing to join in the effort to advance the Convention's purpose of restricting hazardous waste trade to countries unable to safely treat or dispose of it."[28]

Australia's implementation of the Hazardous Waste Act and subsequent commitments to the international Basel Convention requires the Minister to submit annual reports detailing Australia's export of hazardous wastes. In the latest 2019-20 report, the minister granted 33 permits, refusing one permit. Details on Australia's permits for hazardous waste exports can be found here.

28 K A Breitmeyer, 1999, Australia's opposition to the Basel ban amendment on the export of hazardous wastes: when will Australia stop stalling and ratify the amendment?

4. RDF FOR CEMENT PLANTS AND INCINERATORS IN AUSTRALIA

Australia has 19 operating cement plants (see Table 12) that have the potential to use RDF as fuel. According to the industry, most cement kilns can use RDF for up to 50% of their fuel inputs.

Just three companies account for all the cement production in Australia and fall under the Cement Industry Foundation (CIF) – the national body representing the Australian cement industry. The largest company is Cement Australia, followed by Adelaide Brighton Cement and Boral Cement. Adelaide Brighton Cement is leading the charge to use Refuse-Derived Fuel and has reported using 1 mega-tonne of RDF in 2019 at their Adelaide Brighton plant in Birkenhead, South Australia.

Similarly, Boral Cement in New South Wales (the largest supplier in NSW) is currently using 50 000 TPA of Solid Waste-Derived Fuels (SWDF) of which 35 000 TPA is Refuse-Derived Fuel. SWDF is made up of RDF and Wood Waste-Derived Fuel (WWDF).

Boral's aim is to reach 100 000 TPA of SWDF by 2022. However, to reach this target, Boral has to resolve the increased chloride emissions generated through the use of SWDF, which threaten to corrode the plant's internal infrastructure and cause sticky clinker (poor quality product) and high HCl emissions. It can also cause ring scale build up in the kiln, inhibiting product flow. Addressing this will require investment in a new chloride bypass infrastructure and is set to be implemented by 2022 to reach their full SWDF target of 100 000 TPA.

SRF and RDF can contain organic and inorganic chlorine sources including plastics, rubber and cables, especially PVC plastics which have a concentration of chlorine as high as 56 – 74%.

TABLE 12. AUSTRALIAN CEMENT KILNS OPERATIONAL IN 2021

Group Name	Company Name	Facility Name	City
Adelaide Brighton Ltd	Adelaide Brighton Cement Ltd	Angaston Operations	Angaston
Adelaide Brighton Ltd	Adelaide Brighton Cement Ltd	Birkenhead Works	Birkenhead
Adelaide Brighton Ltd	Cockburn Cement Limited	Kwinana Operations	Kwinana
Adelaide Brighton Ltd	Cockburn Cement Limited	Munster Operaions	Munster
Adelaide Brighton Ltd	Morgan Cement International	Port Kembla Operations	Port Kembla
Adelaide Brighton Ltd	Northern Cement Limited	Darwin Operations	Darwin
Adelaide Brighton Ltd	Sunstate Cement Ltd	Fisherman Islands	Wynnum
Barro Group Pty Ltd	Independent Cement and Lime Pty Ltd	ICL Slag	Yarraville
BGC Australia Pty Ltd (Buckeridge Group of Companies)	BGC Cement	Canning Vale	Canning Vale
BGC Australia Pty Ltd (Buckeridge Group of Companies)	BGC Cement	Perth Naval Base	Perth
Boral Limited	Boral Cement Ltd	Berrima Cement Words	New Berrima
Boral Limited	Boral Cement Ltd	Kooragang Works	Kooragang
Boral Limited	Boral Cement Ltd	Maldon Words	Maldon
Boral Limited	Boral Cement Ltd	Waum Ponds Cement Works	Waum Ponds
Cement Australia Pty Ltd and Cement Australia Partnership	Australian Steel Mill Services (ASMS)	Port Kembla	Port Kembla
Holcim (Australia) Pty Ltd	Cement Australia Pty Ltd and Cement Australia Partnership	Bulwer Island Plant	Pinkenba
Holcim (Australia) Pty Ltd	Cement Australia Pty Ltd and Cement Australia Partnership	Gladstone Plant	Gladstone
Holcim (Australia) Pty Ltd	Cement Australia Pty Ltd and Cement Australia Partnership	Railton Plant	Railton
Wagner Investments Pty Ltd	Wagners Cement	Pinkenba	Pinkenba

Source: Cemnet

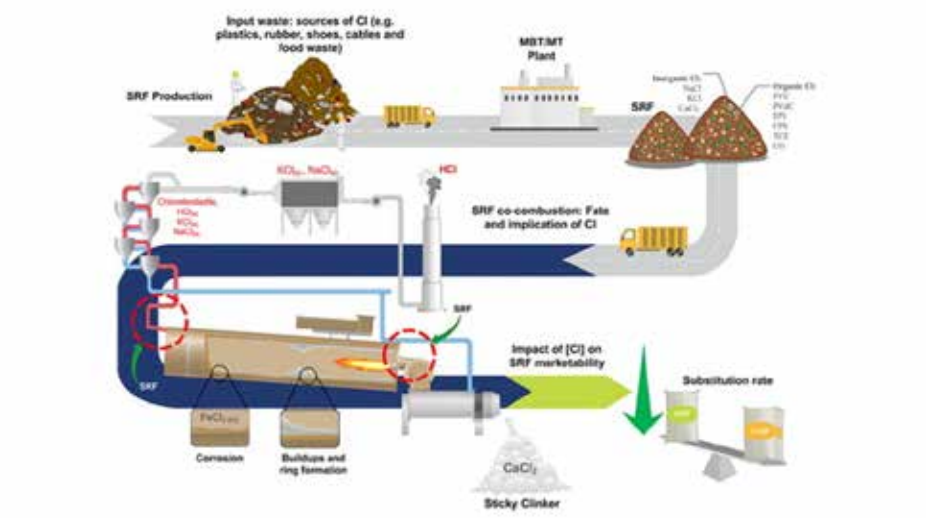


Figure 19. Points of chloride damage in cement kiln. Source: Gerassimidou et al 2021

5. SUMMARY AND RECOMMENDATIONS

5.1 RDF EXPORT BAN

It is increasingly clear that Australia plans to continue and increase its waste plastic exports in the form of reprocessed plastics (sorted into single polymers, shredded, flaked or pelletised) and as Processed Engineered Fuel and derivatives such as TDF, SRF, and WWDF.

While the exact specifications for these exported waste products are defined in the export licences issued to each exporter, it is clear that the importing industry or end user will define the quality, contamination levels, and format of the product to suit their process. In the absence of this information, the Australian government will set these specifications to agreed industry standards.

As this represents the continued export of Australia's waste (especially plastic) in the guise of 'reprocessing' and 'recycling', the export of such waste should be prohibited, especially given the potential health and environmental impacts.

In Australia, the proliferation of PEF production and incineration in the cement sector is significant. The inherent climate, human health, and environmental impacts need urgent quantification, and the use of RDF should be prohibited. Australia should be leapfrogging ahead of this dirty fuel and introducing renewable energy-produced hydrogen (green hydrogen) for cement production as other countries are doing. Australia should become a leader in hydrogen utilisation for energy-intensive industries such as cement and steel production. Instead of exporting dirty, unwanted waste as fuel to low-income countries, Australia should be providing regional leadership and sharing clean hydrogen technology with its South-east Asian neighbours.

5.2 RESIDUAL WASTE RESEARCH CENTRES.

While quantities of residual waste increase globally in line with population increases and improved waste management systems, especially in the global south, the management of this waste stream has great potential for improvement. Zero Waste City models, such as those being implemented

in Europe and the Asia Pacific region, can significantly reduce volumes of residual waste. This is primarily a result of improved waste collection and source separation coupled with waste reduction strategies and broad civil society, business, and industry education.

In Australia, the residual waste level has stagnated at around 20% on average. However, it is entirely possible to reduce this figure to around 10% through better waste management policy and practice.

Residual waste in Australia is predominantly non-recyclable plastics, nappies, sanitary products, textiles, and organic wastes. Australia is implementing a major waste policy shift to reduce the consumption and generation of plastics. Residual waste as a design failure within the context of a zero waste policy is a problem that can be resolved through dedicated research and development such as a residual waste research centre (RWRC). Such a facility and programme could consider the sources and generation of each residual waste that exists and find ways to eliminate or redesign it for circularity. The investment in a RWRC would be comparatively cost effective and safer than building RDF incineration facilities both in Australia and the Asia Pacific region.

The appetite for change in Australia is strong, as numerous frontline communities face incineration and co-incineration threats. Civil society organisations and NGO's[29], academic institutions[30], and industry[31] are working to implement cost-effective, safer, and more sustainable waste management models.

5.3 GREEN HYDROGEN SOLUTIONS

Moving to safer alternative energy sources like Green Hydrogen could leapfrog Australia towards a zero-carbon economy. Moving away from the combustion of solid fuels to a zero emissions fuel like hydrogen has great potential, and is being pursued in Australia and Europe[32].

29 https://zerowasteaustralia.org/zero-waste-solutions/, https://zerowastecities.eu/learn/#the_masterplan https://www.paperturn-view.com/us/gaia/gaia-zero-waste-masterplan?pid=MTE115576&v=2 https://zwia.org/

30 https://www.uts.edu.au/isf/explore-research/projects/wealth-waste

31 https://www.uts.edu.au/isf

32 https://fuelcellsworks.com/news/cemex-successfully-deploys-hydrogen-based-ground-breaking-technology/ https://www.theconstructionindex.co.uk/news/view/hanson-demontrates-hydrogen-powered-cement-production https://www.forbes.com/sites/mikescott/2020/04/06/hydrogen-could-be-the-clean-fuel-of-the-future-for-the-dirtiest-industries/?sh=6cec3a39988d

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Table 4. Frauke Schorcht, Ioanna Kourti, Bianca Maria Scalet, Serge Roudier, Luis Delgado Sancho, 2013. Best Availale Techniques (BAT) Reference Document for the Production of Cement, Lime and Magnesium Oxide. A JRC Reference Reports by the Joint Research Centre Institute for prospective technological studies. EUR 26129 EN. doi:10.2788/12850: pp.506.

Table 3. Alternative Fuel Use in Cement Manufacturing Implications, opportunities and barriers in Ontario, Pembina Institute and Environmental Defence 2014.

Figure 31. Spyridoula Gerassimidou, Costas A. Velis, Paul T. Williams, Marco J. Castaldi, Leon Black & Dimitrios Komilis (2021) Chlorine in waste-derived solid recovered fuel (SRF), co-combusted in cement kilns: A systematic review of sources, reactions, fate and implications, Critical Reviews in Environmental Science and Technology, 51:2, 140-186, DOI: 10.1080/10643389.2020.1717298

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