ZERO WASTE
NEW ZEALAND TRUST

WASTED OPPORTUNITY

A Closer Look at Landfilling and Incineration

Introduction

Modern integrated waste management practices are fundamentally reliant on two core technologies - landfilling and incineration. These burying and burning technologies have become the basis for an enormous multi-billion dollar waste management industry over the last 50 years. Like all large industries it must ensure an ongoing and continuous supply of raw materials to protect its future. In the case of the waste management industry this means protecting the flow of society's discarded resources and channeling as much as possible into landfills and incinerators*.

Growing public concern with these technologies has driven the quest to make them safer, but without challenging the basic assumptions they are built on – that waste is inevitable, that it has no value, and that it can be made to 'go away'.

The arrival of Zero Waste as a vision for a sustainable society has challenged these old technologies and the status quo with a single proposition – let's aim for no waste!

> Zero Waste is a whole-system approach to redesigning the flow of resources through society

Zero Waste is a whole-system approach to addressing the problem of society's unsustainable resource flows. Zero Waste encompasses waste elimination at source through product design and producer responsibility, and waste reduction strategies further down the supply chain such as cleaner production, product dismantling, recycling, re-use and composting. Communities that implement Zero Waste strategies are aiming to switch from wasteful and damaging waste disposal methods to value-added resource recovery systems that will help build sustainable local economies. As such Zero Waste is in complete opposition to landfilling and incineration.

The waste management industry is increasingly adopting new terminology to describe old systems, implying that landfilling and incineration have become environmentally friendly solutions. This is not so, and these practices continue to undermine sound resource management, hinder economic development, and endanger human health and the environment. The resulting confusion means local decision-makers are in danger of being swayed by claims of sustainable waste management practices that do not stand up to close scrutiny.

This report attempts to redress the information imbalance, and provide a summary of reports and documents that give alternative views on landfilling and incineration.

* There are no municipal solid waste incinerators currently operating in New Zealand. However the incineration industry continues to seek opportunities to establish facilities here.

Landfilling

Definitions

A landfill is an area of land onto or into which waste is deposited. A "sanitary landfill" refers to a managed, controlled site equipped with systems to reduce leachate and landfill gas migration into the surrounding environment. A "bioreactor" is a landfill designed to speed-up microbiological degradation of materials by recirculating leachate, adding water and nutrients, and other process-enhancing strategies. Despite these technological improvements, the basic concept remains the same: landfills are simply places to hide wasted materials.

A municipal solid waste (MSW) landfill is not a benign repository of discarded material; it is a biochemically active place where toxic substances are leached from material, or created from combinations of non-toxic precursors, and gradually released into the surrounding environment over a period of decades. A landfill that opens for business in New Zealand today will operate for approximately 20 years, and the operators will be committed to a post-closure care period of only 30 years. However, the potential impacts of a landfill extend far into the future, well beyond the next 50 years [1].

Although the past decade has seen marked improvements to landfill management and regulations, a landfill is not – and never will be, an environmentally, socially or economically "good thing". Those who argue that landfills will always be a necessary evil are ignoring the facts; waste has reached an historical turning point, and the emerging secondary materials economy is driving technological innovations towards an era in which the landfill is a dinosaur.

Leachate

Landfills, whether they accept only municipal solid waste or hazardous waste, are not innocuous [2]. Municipal landfill sites produce leachate containing toxic chemicals in concentrations startlingly similar to those of hazardous waste landfill sites [2,3]. Leachate production is a result of rainfall and surface or ground water entry into the landfill site. Leachate leakage is dependant upon the relative permeability of the landfill liner. Modern landfills must be constructed with an impermeable liner of compacted clay and/or geosynthetic material to contain leachate. However, regardless of the nature of lining and the guarantees offered by landfill operators on the durability of landfill liners, it is universally accepted that all landfill liners will ultimately fail [4].

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Landfill leachate has been responsible for contaminating ground water supplies and surface water ecosystems in communities all over the world [5,6]. In the USA, more than 75% of the sanitary landfills are polluting ground water with leachate [7]. Amongst the hundreds of toxic substances found in landfill leachate are lead, cadmium, chromium, mercury, toluene, dioxins, organophosphates, and PCBs. New Zealand has not been immune, and cases such as the toxic waste dump at Mapua [8] highlight the potential dangers posed by landfill leachate to New Zealanders. The extent of damage by leachate is largely unknown, given the complexity of leachate flows within landfills, the complex systems of aquifers, which may be impacted, and a lack of data. Although the impacts are uncertain, the precautionary principle should apply given the toxic nature of the materials involved.

Landfill gas

As waste decomposes, the combination of chemical, thermal, and microbial reactions release gases. Landfill gas is a combination of methane and carbon dioxide in almost equal parts, with the remaining 0.01% to 0.6% composed of carcinogenic volatile organic compounds, such as benzene, toluene, xylenes, carbon tetrachloride, and others [9,10]. Landfill gas may collect in uneven pockets within the landfill, gradually seeping out through the ground or waste mass, or building up pressure until an explosion or uncontrolled fire occurs. Landfill fires are a common occurrence; Sweden estimates approximately 220 fires a year (there are about 400 landfill sites in Sweden), and landfill fires are responsible for releasing approximately 1,050 gm TEQ (toxic equivalent) per year of dioxin to air in the USA [11].

Social impacts

Health

Increased incidence of several types of cancer (bladder, lung, stomach, leukemia, and rectum) has been reported in people living near landfills where landfill gas is migrating through the soil [12,13]. Medical evidence shows that living near landfill sites increases the overall risk of birth defects, including 5% increase in the incidence of neural tube defects such as spina bifida and 7% increase in genital defects in boys [14-16].

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Bacterial processes in landfills contribute to concentrations of methylated mercury species in the atmosphere. Although methyl mercury has been detected in air and rain, the actual source of this pollutant was unknown until recent studies showed high concentrations in landfill gas, indicating that landfills might be a major source. Sources of mercury include products such as fluorescent light bulbs, batteries, and latex paint. Foetal exposure to methyl mercury causes thousands of developmental impairments in children each year, and the only means of preventing this is by eliminating sources of methyl mercury [17,18].

Socio-economic factors

Near urban centres, landfills are generally located in low-income areas, where residents have less political influence to prevent landfill development or simply cannot afford to live elsewhere [19]. In New Zealand, isolated rural areas have tended to replace low-income areas as the primary recipient of new landfill developments. The issue of landfill siting is politically charged, and generally creates disharmony within communities.

Economic impacts

Tourism and exports

New Zealand has a unique set of economic considerations with respect to landfills. Tourism in New Zealand is a $9 billion industry, is the country's largest export earner, and accounts for 1 in every 12 jobs [20]. The tourism industry's success is largely based on marketing New Zealand as an eco-tourism destination with a clean, green image. Landfills detract from this image and have the potential to severely impact tourism. Images of uncovered New Zealand landfills are already on the internet as an example of poor landfill management [21].

Landfills pose a threat to New Zealand's valuable primary produce export trade – valued at around $25 billion [22], which could be endangered by images of rubbish tips in the rural countryside. One very sensitive sector is the expanding viticulture industry, whose overseas markets could baulk at the idea of purchasing wine from areas where landfills are located near vineyards [23]. Zero Waste, on the other hand, provides protection for export markets, reassuring global buyers that New Zealand's clean, green brand is credibly supported with policy and practices that guard against environmental contamination.

Landfill economics

As the number of landfills in New Zealand declines due to closure of small, poorly managed sites under the requirements of the Resource Management Act, new landfills generate high profits because, once established, they can control monopoly rent [19]. The current charges for disposal of waste to landfill in New Zealand do not reflect external environmental costs. However, the cost of disposing of waste to landfill is increasing due to rising land prices, higher taxation, and more stringent environmental requirements [24]. In short, landfill operators are able to internalise the short-term profits while externalising the long-term liabilities.

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In contrast, recycling represents a declining cost industry; as more waste is diverted to recycling activities, the costs of programme implementation and operation decrease. Whereas in the long-term landfills deplete local economies, intensive recycling programmes have been shown to generate local economic gains [19]. In addition, waste minimisation initiatives produce the highest cost benefits in terms of environmental externalities (ie: environmental costs or benefits that are not reflected in market transactions, such as virgin material depletion or reduced greenhouse gas emissions). For instance, in Australia, it was estimated that the net environmental cost benefit for kerbside recycling programmes amounted to around $42 per household per year [25].

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Employment

Landfilling waste generates less employment than recycling; for the same amount of material, 3 to 5 times more jobs are created by recycling rather than landfilling [19]. In the Baltimore, Washington, and Richmond region of the United States, 5,100 people are directly or indirectly employed in the recycling industry compared to 1,100 people in the waste disposal industry – even though 3 times as much waste is handled by disposal [19]. Ohio employs around 100,000 people in recycling and reuse enterprises, generating an annual payroll of $3.6 billion and $22.5 billion in annual revenues [26]. And in the Auckland region, approximately 2,000 people were shown to be directly employed in 64 recycling businesses surveyed, with a gross annual turnover of at least $132,000,000 [26].

Many of the jobs created by recycling and recovery are so-called "green collar" jobs, involving material collection, management, supervision, sorting, frontline quality control, public relations, and data analysis. This is a far cry from the "picking-over-rubbish" description used by some cynics in reference to New Zealand's potential recycling workforce.

Lost opportunities

New Zealand is essentially paying to dispose to landfill materials that could be creating income through recycling materials, creating jobs, and saving on the amount spent on imports. Waste is a productive resource, capable of generating new opportunities for local economic development. When buried in landfills it wastes jobs as well as resources.

Environmental impacts

Greenhouse gas emissions

On a global scale, landfills are responsible for approximately 10% of anthropogenic (human-made) methane [28]. Landfill gas collection systems do not prevent significant emissions of the harmful greenhouse gas, methane, from landfills. A common misconception is that a landfill gas collection system captures the majority of methane (75% or more) produced in a landfill, which is either flared off or used to fuel power generators [29,30].

In fact, less than 50%, and possibly only 10% – 20 %, of methane produced is likely to be captured due to inherent inefficiencies of collection systems [31]. For example, in order to prevent an explosive mixture of oxygen and methane as gas is pulled from the landfill with a vacuum pump the vertical collection pipes cannot be properly perforated at the top third to half of the pipe. Furthermore, the pipes cannot extend to the very bottom of the waste mass (where saturation would result in lots of methane production) in case they pierce the bottom liner as the waste decomposes and subsides. Also, methane collection systems are generally not installed until the waste reaches a certain depth, and a significant proportion of the organic material such as kitchen waste has already decomposed by this time. Pipe blockages from plastic bags, leachate pooling in pipes, and waste mass densities impeding gas flow also account for low methane capture rates [31].

Recycling greatly reduces greenhouse gas emissions compared to landfilling the same material [32]. If New Zealand is serious about its commitment to the Kyoto Protocol, then actively developing a Zero Waste strategy presents serious advantages over landfilling: for every tonne of waste diverted from landfill, 0.8 metric tonnes of carbon equivalent are saved [33].

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Energy from methane

The situation tends to worsen when a landfill site is being managed for power generation from methane. To run power-generating facilities at higher efficiency, operators will want to pull more of the denser gas generated at the centre of the site. This reduces vacuum pressures towards the landfill's boundaries, which results in gas emissions and/or dangerous build-ups at the periphery, closest to the landfill's neighbours [34].

Methane generation continues long into the future, past the usual mandated post-closure care period when the methane collection system will be removed [35]. The contribution of post-closure landfill methane to global warming continues to be significant, and claims of huge greenhouse gas reductions by landfills operating methane collection systems generally are not supported by the facts [35].

Systems that produce energy from methane also undermine the global push to divert organic matter, such as paper, cardboard, food waste, and yard waste from landfill, since organic matter is essential for methane generation. In contrast, composting food and yard waste in windrow or vermiculture systems produces comparatively little greenhouse gas due to the aerobic processes involved.

Groundwater contamination

Landfill leachate contains a wide range of toxic substances arising from the decomposition of waste, and causes contamination of domestic groundwater sources and eutrophication (deterioration of water ecosystems through oxygen depletion) of watercourses [5, 6]. Substances found in leachate, such as toluene and mercury, are toxic to living organisms that come into contact with leachate-contaminated water or soil. Assurances by landfill operators that leachate is always safely contained and managed within a landfill liner are false: researchers and practitioners agree that liner failure is inevitable, regardless of the liner type [4, 36, 37]. That all liners will eventually fail is not disputed, the only question is when.

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Responses to common arguments

"Even if resource recovery programmes reduce waste by 85%, there will still be a residue that needs to be landfilled, therefore New Zealand needs landfills".

The Zero Waste philosophy accepts that there will be a steadily shrinking residue of waste requiring disposal for some time into the future. Since New Zealand currently uses landfills as the main disposal method, it makes sense to make use of existing facilities for that residue. This does not mean that landfilling is acceptable practice; it is merely providing an interim measure while creativity and resources are focussed on finding innovative solutions to eliminate waste. Considerable effort does need to be directed towards improved landfill operation in terms of environmental protection and post-closure responsibility. However, New Zealand as a nation must concentrate on waste elimination and not waste disposal.

"A properly designed and managed landfill is environmentally benign".

Good landfill design and management certainly reduces the environmental impacts of leachate and landfill gas. However, as long as leachate and landfill gas are generated (which cannot be prevented in a landfill), then the landfill poses an environmental threat. Leachate will leak from the landfill liner at some stage during active landfill operation or the post-closure period, resulting in some degree of contamination. Even low-permeable substrate underlying a landfill will incorporate fissures and faults, which may channel leachate into ground water aquifers.

Aquifers themselves are so complex and difficult to accurately delineate that leachate contamination may only become apparent some distance from the source. Leachate does not necessarily migrate fan-like from a landfill, therefore even closely spaced monitoring wells may not enable detection of a narrow plume of leachate exiting the site. As discussed above, no landfill gas collection system can effectively eliminate landfill gas emissions; therefore environmental impacts from methane, carbon dioxide and toxic gases are inevitable.

"New Zealand can earn greenhouse gas credits from methane collection and energy generation".

Methane collection for energy production is an inefficient process, as outlined above. Furthermore the amount of greenhouse gas emissions that could be saved by recycling the same material far outweighs the amount that could be saved through methane collection and energy production. Landfill gas methane is most definitely not a source of renewable energy. The organic material in a landfill, which leads to methane generation, is a valuable resource that should be introduced back into the natural cycle by composting or other treatment, rather than being destroyed in a one way trip to the landfill.

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Incineration

Definitions

Incineration refers to the combustion of waste materials, resulting in ash residues and air emissions. Gasification, pyrolisis, and vitrification are variations of incineration, and waste-to-energy refers to an incinerator that incorporates technology to generate power from the heat produced during the combustion process.

Waste incinerators do not eliminate waste – in fact they generate it. Since physical matter cannot be destroyed, an incinerator actually transforms the original wasted materials (or resources) into several new forms of waste: air emissions, ash, and liquid discharge (resulting from cleaning processes within the incinerator). Incinerators reduce solid waste to approximately 45% of its original volume, which exits the incinerator in the form of fly ash and bottom ash [38]. (Claims of reduction to 25% of volume are based upon optimum incinerator operation, which rarely occurs, as discussed below). These new forms are far more difficult to deal with than the original, raw wasted materials.

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International resistance

Global resistance to incineration is growing, with communities around the world banning incinerators, particularly in Japan, Europe, and the USA where incineration has had a long and unhealthy history. Incinerator companies experiencing declining popularity and sales in these areas are now seeking new markets for expansion. Developing countries such as Thailand have already been submitted to a number of disastrous incinerator projects. New Zealand, so far free of municipal solid waste incineration, is being eyed as another potential client. Incineration of 'clean' or single material waste streams such as wood or coal for domestic heating or sawdust for industrial power generation occurs within New Zealand. Although still a source of air pollutants, this type of incineration is a far cry from mixed waste incineration because the inputs are known and can be managed much more safely. However at this point, and until the outcome of further research and consultation is completed, this report does not endorse incineration technologies of any type for wasted materials.

Social impacts

Human Health

Air emissions from waste incinerators have been positively identified as a cause of cancer and other health damage in humans.

The incineration of solid waste leads to air emissions containing heavy metals, dioxins, and other volatile organic compounds [39-41]. These pollutants may be transported for considerable distances downwind from incinerators, with significant pollutant levels being measured within several kilometres of a facility [42]. Although many waste incinerators have now been equipped or updated with improved air pollution control techniques, toxic emissions are still being released to the atmosphere. At optimum operating levels, these emissions are small, but incinerators rarely perform to optimum, or even required, standards [39-41]. Emission violations and malfunctions are common even at new, state-of-the-art incinerators due to mechanical and operational problems, and it is "technically remote to achieve even 80% continuous compliance" with air emission regulations [39].

Dioxins are the most toxic man-made substances and are "formed from precursors that are either constituents of the waste or are also formed by chemical recombination of materials in the waste" [42]. The predominant source of dioxins is products containing chlorine, such as PVC plastic. Dioxins can be destroyed during combustion in an incinerator but can also be regenerated by processes in the post-combustion zone. It has been shown that the total amount of dioxins exiting an incinerator in various forms can exceed the amount entering as raw waste [41,42].

Even small quantities of pollutants such as dioxins, furans, and mercury can be detrimental to human health and the environment. Many of these substances (dioxins in particular) can be carried long distances from their emission sources, persist for decades in the environment without breaking down into less harmful compounds, and accumulate in soil, water, and food sources [43]. Small amounts of toxic substances can gradually build-up in the tissues of organisms to reach critical and fatal levels. Therefore, even tiny emission levels of these substances are unacceptable and slowly but surely lead to the eventual poisoning of communities and ecosystems.

Incinerator workers are exposed to high concentrations of dioxins and other toxic substances resulting from in-plant waste combustion emissions, regardless of the standard protective equipment worn [42-45].

Populations living near incinerators are also at risk of health impacts from toxic air emissions, particularly those living downwind who receive the most toxic "fallout". Although emissions may be diluted and dispersed over space and time, the chronic exposure to low-level doses of environmentally persistent, toxic substances has the potential to cause human health issues after a long latency period.

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Studies of communities living in the vicinity (ie: 0.5km to 5km) of municipal solid waste incinerators have shown elevated levels of dioxins in blood samples, compared to background population levels [42]. High concentrations of dioxins have also been found in dairy products and vegetable crops originating from agricultural areas near incinerators [42], and intake of these food items contributes to increased dioxin levels in humans. Therefore, the impact of an incinerator may be far-reaching if toxin-laden produce is exported outside the local community.

Polyaromatic hydrocarbons (PAHs), polychlorinated biphenyls, dioxin, and other commonly emitted substances from incinerator stacks have been classified as human carcinogens or likely/possible human carcinogens [46]. In particular, soft tissue sarcoma, non-Hodgkin's lymphoma, lung cancer, liver cancer, and cancer of the larynx have been positively linked to exposure to incinerator emissions [42, 47]. Children are particularly vulnerable to toxic exposure, and develop cancers after only short exposure times [48]. Increased congenital abnormalities, such as orofacial clefts, spina bifida, and genital malformation in infants have also been attributed to incinerator emissions, particularly to dioxin [42].

Ash is a product of incineration. Bottom ash consists of post-combustion waste residues and non-combusted materials, including heavy metals, and fly ash is composed of particles captured in air filters. Reducing toxins in air emissions results in increasing levels of toxins captured in fly ash, which will eventually leach into soil and water from landfill ash deposits. Attempts have been made to divert ash from landfill by incorporating it in roading and cement block construction, with incinerator operators claiming that the ash consequently becomes inert. Research has shown that this is not the case, and heavy metals in particular are leaching from roading material and cement blocks incorporating incinerator ash, endangering local ecosystems and communities [49]. In one case in Newcastle, UK, where ash from a local incinerator had been applied from 1994-1999 on local allotments and paths, hazardous levels of dioxins and heavy metals were found. Amongst other warnings, residents were advised to keep infants off the allotments and refrain from eating egg and animal produce from the area [50].

Employment

Waste incinerators do not create long-term job market growth. Incinerators are operated by a relatively small number of staff, and the presence of an incinerator in a region does not attract other industries to the area [41]. Reuse and recycling initiatives provide more than 10 times as many jobs as incineration for a given quantity of material processed [51].

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Economic impacts

Flow control

Waste incinerators require large capital investment and show little economic return. In order to maintain optimal combustion incinerators need a constant supply of waste, often resulting in the creation of long-term contractual agreements with local authorities guaranteeing a certain tonnage of waste per year to the incinerator [41]. This effectively destroys incentives for local decision-makers to minimise waste or financially support resource recovery programmes.

Claims that incineration complements recycling programmes are false; incinerators need material with high calorific value, such as paper, cardboard, and plastics to maintain combustion levels, and they make money by scavenging recyclable metals from the ash [52]. In fact, the only materials in mixed waste that exceed the average calorific value of standard power-generating fuels (such as natural gas, coal, diesel, etc) are waste oils, solvents, and plastics, which produce air emission problems when burnt [19].

Ongoing landfill requirement

Landfills are still required for the disposal of bottom ash and fly ash, therefore the operational costs of a landfill must be added to the operational costs of an incinerator. Furthermore, because of the increased concentration of toxins in fly ash, it is considered a hazardous substance, and requires an additional and very costly hazardous materials landfill [41]. As discussed above, the use of ash in roading and cement blocks is not acceptable practice, and landfill costs cannot be avoided.

Waste-to-energy

Mixed-waste incinerators are inefficient energy producers, capturing only about 20% of energy generated by the waste [19]. Waste-to-energy proponents stress their energy production potential and consequent reduced use of fossil fuels without addressing a far more important issue: the huge loss of resources and energy already used to produce the material being burnt [52,53]. In fact recycling plastic saves 3.7 to 5.2 times more energy, recycling paper saves 2.7 to 4.3 times more energy, and recycling metal saves 30 to 888 times more energy than is gained through incineration [52].

> Mixed-waste incinerators are inefficient energy producers, capturing only about 20% of energy generated by the waste.

Environmental impacts

Environmental impacts of incinerators are inextricably linked to human health impacts; exposure to toxic air emissions creates a hazard for the health of all living organisms.

Studies of soil and vegetation in the vicinity of waste incinerators have found elevated levels of dioxins and heavy metals compared to background levels of non-contaminated areas [42]. Dioxins and certain heavy metals bio-accumulate in the food chain: small quantities found in vegetation are transferred to organisms that consume the vegetation, where they accumulate predominantly in an organism's tissues, and are then transferred to the next feeding level. Therefore, animals grazing vegetation in the vicinity of an incinerator ingest toxic substances, which are then passed onto both their predators and their young through milk. Cow milk sourced from herds grazing in areas subject to incinerator emissions has been found to have high concentrations of dioxin [42, 54].

Waste-to-energy

Waste-to-energy facilities are increasingly claiming to make use of a renewable energy source. Waste is not a source of renewable energy: waste is composed of materials produced from natural resources, such as plastics derived from exhaustible fossil fuels, and paper and cardboard from diminishing virgin forests. Burning this material destroys what are essentially urban reservoirs of resources. For example, the Food and Agriculture Organisation (FAO) estimates that no more than two fifths of the growth in

> For every tonne of mixed material recycled, 0.8 MTCE (million tonnes of carbon equivalent) are saved, which is four times as much as by incineration.

paper consumption projected for the next 10 years can be accommodated by virgin wood sources [19]. In other words, paper needs to be recycled in order to feed the world's paper mills and prevent mass destruction of virgin forest. Claims that paper recycling is expensive and energy-intensive are outdated: a modern de-inking mill consumes 3-7 times less energy than a primary paper pulp mill and costs 35% less to produce a paper product [19].

Recent studies by the United States Environmental Protection Agency show that for every tonne of mixed material recycled, 0.8 MTCE (million tonnes of carbon equivalent) are saved, which is four times as much as by incineration [19].

Responses to common arguments

"The dioxin emissions from an incinerator are less than the dioxin emissions from car exhaust".

The notion that cars put out more dioxin than incinerators goes back to a Swedish study (1986), which reported that the total dioxin emissions from all the automobile traffic in Sweden approximated the dioxin emissions from all their waste incinerators (about 20 at the time). However, that estimate was made on the exhaust of cars running on leaded gasoline, which leads to the formation of dioxin. Since this time however, in Sweden, and most other countries, lead has been phased out of gasoline and thus this source of dioxin has been greatly reduced. It is also true that the dioxin emissions from incinerators have been reduced by several orders of magnitude. However it is highly unlikely that even under the best of circumstances an incinerator puts out less dioxin than a single car running on unleaded fuel. It is conceivable that the dioxin emissions from one incinerator might approximate the dioxin emissions from all the cars in a city. Before getting carried away with this comparison it needs to be pointed out that no one is building waste incinerators as a substitute to automobile transport and thus the exercise is a little hollow.

"Waste incineration can generate energy – it's a renewable energy source".

As discussed above, waste definitely does not represent a renewable energy source. Waste is composed of materials produced from unsustainable and non-renewable sources. By incinerating waste we are essentially destroying a wealth of resources that could be recovered through a secondary materials industry, and ultimately minimised through more efficient production processes. The energy saved by intensive recycling greatly exceeds the energy gained through waste incineration.

"We need incinerators to safely handle medical and quarantine waste".

Incineration of medical and quarantine waste is not a safe solution. Only about 15% of medical waste is potentially infectious [54]. Although incineration certainly kills pathogens, it changes a potential biological threat into a formidable set of chemical problems by destroying not only the pathogens, but also the materials on which the pathogens sit such as plastic, glass, paper, and metal [54, 56]. This is especially important as many medical supplies are rich in PVC, which is one of the worst materials for producing dioxins when combusted.

Coordinating initiatives with suppliers of medical equipment could help minimise the waste generated, and effective sorting of medical waste at source could divert most of it for reuse and recycling. Alternative treatments for the remaining infectious wastes include: autoclaving (high pressure steam treatment), microwaving moistened waste, and sterilisation by disinfectant (chemical sterilisation) [54, 56]. Rather than accepting incineration as the only option, New Zealand needs to lead the way in developing and applying alternative technology for handling medical waste.

Summary

Landfills and incinerators are outdated technologies that do not have a place in a sustainable society of the 21st century. However, vested interests are still promoting them as safe waste management solutions.

Zero Waste is not a technology in itself, but rather a vision for a new way of designing material flows and a sustainable society. It includes a basket of technologies and solutions that will collectively refocus the energy and resources of communities throughout the nation towards waste elimination – with consequent social, economical, and environmental benefits.

Zero Waste is now firmly on the agenda for New Zealand, with over 50% of our local authorities aiming for Zero Waste and with a new national Waste Strategy policy entitled: "Towards zero waste and a sustainable New Zealand".

Communities cannot solve the waste crisis alone. However, every community can adopt a Zero Waste target to change the way its citizens think about waste, and to send a firm message to industry that communities will not always clean up after it. Industry must take greater responsibility for its own products throughout their entire life cycles.

In the final analysis landfills and incinerators destroy valuable resources. Even if they were proved 'safe' this destruction of resources would be enough reason to condemn them as outmoded disposal technologies. The final goal for a sustainable society is to create a 100% materials-efficient economy – a Zero Waste economy based on the same principles that nature has successfully proven for millions of years.

For further information on Zero Waste principles and practices see the Zero Waste website **www.zerowaste.co.nz** .

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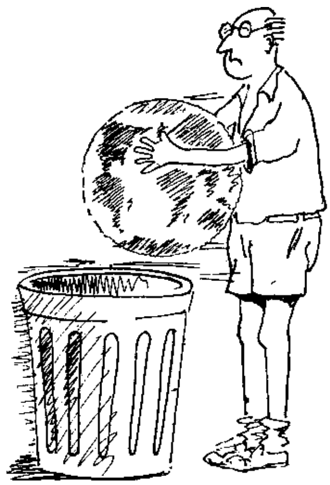

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