Submission
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INQUIRY INTO PROPOSED ENERGY FROM WASTE FACILITIES

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Inquiry Submission

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The NSW community expects better than large scale incineration of municipal solid waste (MSW) by a polluting process that: avoids thorough resource recovery and technological advancements, encourages a single use and unsustainable economy where recyclables have been combusted, increases greenhouse gas (GHG) emissions at a time the planet needs reductions and that this method of waste disposal is known to have adverse effects on entire ecosystems and on the physical and mental wellbeing of citizens who are concerned expedient decisions for waste management are being made to their detriment. The economic fallout will be disadvantageous to the regions unwillingly hosting the incinerators. How is it reasonable for a city to shift pollution to farming areas that supply food to urban centers, probably lowering food standards, risking a downgrading of export quality that would affect farm incomes, national income and tax receipts? Shouldn't a city take responsibility for its own waste rather than shifting the known hazards to less densely populated but nonetheless important regional areas?

Frontier Economics "The management and treatment of waste is an important environmental and economic issue. Poorly managed waste may increase GHG emissions and negatively impact local water, land and air quality. However, waste also represents an economic opportunity. Certain waste streams may be reused or recycled for a range of productive purposes. Making use of waste streams is the basis for moving towards a circular economy model and more efficiently using primary resources." [1]

NSW EPA, “The EPA has applied the following overarching principals to waste avoidance and recovery:

- higher value resource recovery outcomes are maximized
- air quality and human health are protected
- ‘mass burn’ outcomes are avoided
- scope is provided for industry innovation.” [2]

It’s worth considering how closely a waste-to-energy incinerator (WtE) with a design such as the current proposal by Veolia for the Woodlawn site, fits with the above criteria? There are numerous valid concerns as to whether the design of the incinerator planned by Veolia for Woodlawn Eco-precinct is fit for purpose, for instance only having a mid-range temperature setting of 850^{0}C that’s insufficient to fully destruct a great many synthetic chemicals, many designed to be fire resistant and persist in the environment. In the conclusion to Chapter 3 - Strategic Context, of Veolias EIS, regarding the choice of WtE technology, point 4 says, “uses the most common form of technology.” [3] To say something is the most common form of technology is not the same as saying it is the most advanced or best available technology. Also in Chapter 3, “There are a number of different technologies that exist for the combustion of municipal derived waste fuels. In general, the proven technologies can be grouped into four main categories as follows;

- Moving Grate
- Fluidized Bed
- Gasification
- Pyrolysis” [4]

It’s important to note that Veolia states there are four proven technologies. However, the last two mentioned, gasification and pyrolysis are not straight combustion for electricity but lead to the production of other products such as liquid fuels, ammonia and other tradeable chemical commodities. It seems possible that Veolia supports the moving grate system because it’s the technique that it is most familiar with constructing, not necessarily because it’s the best available technique (BAT).

Flue Gas Treatment

There are strong indications the planned flue deacidification system designed by Veolia for its WtE incinerator at the Woodlawn Eco-precinct is less than best practice: being only a dry lime dusting method rather than a combination of both dry and wet methods as recommended by VinylPlus, the European PVC industry representative body to European incinerator operators on how to best neutralize the hydrogen chloride gas given off in the combustion of Polyvinyl chloride (PVC). VinlyPlus, “The wet process is both the most effective and least harmful to the environment” and “The semi-dry and dry systems produce significantly more residue material.” [5] Dry scrubbing followed by, a wet scrubbing in cascade, is popular in Europe to comply with the latest EU emission laws for waste incineration. Veolia itself says, “There are also a range of options and variations available for the flue gas treatment (FGT) systems and their components.” [6]

Veolia could be asked to explain its reasons for opting for the dry method only so that more certainty surrounds their plans for BAT deacidification of flue gases by their FGT. Both the residues of the dry and wet methods can be incorporated into the air pollution control residues (APCr) concrete binding mixture, to go into the APCr containment capsule and Veolia who claim expertise in wastewater processing should have no issue dealing with neutralized water remaining after the ‘wet method.’ Needless to say the cement binder for this material should be of a high quality and reinforced, or contained in a reinforced concrete chamber, that is designed to resist cracking and leaching into the water table and to be sulphate resisting to resist decomposition from standard acidic subsoil conditions, further exacerbated by the fact the old open cut mine itself – within the Woodlawn Eco-precinct - is a massive sulphide ore deposit.

Chlorine containing PVC is the world’s third most widely produced plastic polymer. “PVC is easy to process, long lasting, tough and light” The British Plastics Federation says of PVC. PVC resin is a halogenated organic compound, where one or more hydrogen atoms have been replaced by a halogen: chlorine, fluorine, bromine or iodine, creating very strong bonds.

The European Chemicals Agency (ECHA), European Union lists 122 halogenated hydrocarbons in its substance information card on this class of chemicals, which are substances of very high concern (SVHC) used in polymers, resins or compounds, in foams or as intermediates. Companies must notify ECHA and inform customers if any Candidate List substances are present, warning many are DNA damaging carcinogens and will affect reproduction. [7] It has to be reasonable to assume that many SVHCs end up in NSWs MSW and therefore be a part of an incinerators feedstock.

On combusting halogenated hydrocarbons, the NSW EPA says of the design of an incinerator, “If the waste fuel fed to the primary (first) combustion chamber has a content of more than 1% of halogenated organic substances, expressed as chlorine, the temperature should be raised to 1,100^{0}C for at least two seconds after the last injection of air.” [8]

This is not possible with the model of moving grate waste incinerator Veolia is proposing for Woodlawn. In fact Veolia’s EIS is short on any details about how an additional fuel such as diesel or methane is used to ensure their 850^{0}C burn temperature is achieved on start up, and then maintained when necessary. Once MSW is combusting the 850^{0}C can possibly be consistently achieved by the chamber design and air injection alone but not at any considerable temperature above 850^{0}C, without an additional fuel source. It’s basic theory in engineering to set strength factors at some level above a critical point, in some cases 50% higher. This gives a strong indication that a best practice burn temperature should be 1,100^{0}C + x % and 1,200-1250^{0}C may be adequate. The design could include a final chamber that can reach these temps. Cement kilns and steel making furnaces operate at around 1500^{0}C and may offer some design clues, the principals are very similar: heat a kiln or furnace to the correct temperature and load your feedstock. The idea here is to heat the flue gases up to higher temperatures in a final stage, the extra investment to achieve these higher temperatures could be returned by more steam generated electricity.

As well as PVC there is a profusion of other toxic substances in our waste streams to consider that would be incinerated at what's suggested is an inadequate temperature, naturally anything that can be disposed of in a bin probably will be. The NSW EPA, "The definition of waste covers a range of materials that vary in their origin, composition, contamination and risk profile." [9]

The NSW EPA, "Clean air is fundamental to everyone's wellbeing: poor air quality can be particularly critical to the health of children and chronically ill and older people as well as affecting the natural environment and amenity of communities." [10]

There is nothing ambiguous about the word "everyone" in this statement and the residents of regional NSW would understand that "everyone's wellbeing" includes them. The town of Tarago, 6km from Woodlawn Eco-precinct, has a school of 50 students and is surrounded by farms with a considerable workforce. As has been well documented by submissions to this and other inquiries, the plume fallout would reach much farther than Tarago, indeed it is expected to cross the NSW ACT border and impact the residents of the ACT and Queanbeyan. NSW EPA, "The operators of an energy from waste facility will need to be 'good neighbours' – particularly if near a residential setting but also where there are workers in other facilities." [11] What are the residents of the ACT thinking about the prospect of breathing in emissions from the incineration of NSWs waste?

It's accepted that the plume fallout of incinerators is known to have negative effects on the environment as quantities of potential hazardous elements (PHEs) create hostile environments that limit proper organism development and the incineration of MSW is a significant source of historical and contemporary emissions that have contributed to climate harm in the past and will continue to harm the climate system. An approved waste incinerator should have a temperature setting that will adequately combust any residual waste left over after thorough resource recovery has been undertaken.

MBT

The most common current resource recovery method from a mixed waste stream is mechanical and biological treatment (MBT). MBT undertakes the removal of solid materials for reuse, remanufacturing etc. by mechanical means, often including some hand sorting and what remains is a considerable fraction of organic matter depending on how much inorganic material – like plastic, metal, and minerals - has been removed and now undergoes the biological stages. This is done either sealed in landfill or in a chamber, both known as biodigesters, to undergo anaerobic digestion (AD), that is digestion by bacteria that exist in an oxygen free environment and emit methane as a byproduct of metabolism. Or aerobic digestion, generally done in heaps turned in the open air where micro & macro-organisms break down the organic material - giving off mostly CO_2 laden greenhouse gases GHGs in the process. These aerobically broken-down organics historically enter a supply chain as a mulch, composted material or soil improving product depending on the time spent undergoing the aerobic digestion. However, at present cross contamination of the organic fraction by remnant inorganic matter left over after mechanical separation is impossible to avoid, where a quantity of inorganics remain in the organic fraction after mechanical sorting and this residual inorganic matter contains hazardous elements, think microplastics, asbestos and spilled chemicals. This means MBT of MSW cannot result in producing a mulch or composted soil improving product that is not contaminated with PHEs and therefore anerobic digestion resulting in methane - that is a useful chemical with many applications - is the recommended option for the biological processing of MSW.

How well MBT is done depends on several factors such as: society's will to take up and invest in advanced technologies, finding and even creating new products and markets for recycling materials and supportive governments that will identify potential and settings that will assist to further the transition to a circular and clean economy. If the answer is waste management improvements are a bit too difficult and settle for the cheapest, easiest and most polluting solutions, society has fallen at the first hurdle.

Recycling decisions made by waste operators who are also providing feedstock to incinerators can result in cherry picking resource recovery that has the most favorable current market price, as well as retaining a preferred plastic fraction for use as incinerator fuel; this then translates into an export income from electricity generation for them and reduces their landfill costs. The concern here is that an incinerator would not encourage maximum resource recovery but rather the opposite and drive decision making that is detrimental to progressing the circular economy and add some level of unnecessary GHG emissions over the lifetime of the incinerator.

Innovation

The stockpiling of recyclable materials need not be seen as a negative as this material can act as a feedstock for new and innovative products, stockpiles can also be strategic buffers against supply chain disruptions. Recent developments in plastic recycling has seen industry produce individual products containing multiple plastic resins. When plastic is recycled it's not released into the environment in detrimental ways.

Worldwide waste management is undergoing a technological revolution where there's a rapidly increasing number of enterprises developing processes to interact in increasingly inventive and scientific ways to 'remanufacture' waste by examining what's in waste and what products will have a pre-existing demand. These innovative companies are attracting investment, working on the principal that waste is simply molecules that need reassigning, or the old chestnut, "one man's trash is another man's treasure."

Among many notable Australian clean tech start-ups are these award winners:

- [12] MCi Carbon, who have received international recognition and contracts for their process to lock CO_2 into magnesium silicate bearing waste and natural minerals to form a magnesium carbonate building material and silica

- [13] Samsara Eco, who are applying ground breaking enzymatic biotechnology to break plastic polymers down into basic monomers for remanufacturing
- [14] Wildfire Energy, Wildfire says, "Wildfires MIHG (moving injection horizontal gasification) waste to hydrogen and MIHG waste to methanol technologies have a net negative greenhouse gas emissions footprint by avoiding either landfill emissions or incineration. Each technology can be optionally fitted with carbon capture to reduce greenhouse gas emissions even further." "Methanol can be used to produce chemicals, fuels and sustainable aviation fuel." Wildfire's process can produce fuel from a mixed waste stream or selected waste, "such as biomass, contaminated food wastes, dried and/or mixed biosolids, automotive shredder residues, waste plastics and packaging, co-fed animal manures and other wastes." Wildfires (or a tech company like Wildfire) modular construction means it could set up in a way to service a number of suburbs or a town, as well as large scale like the concept of Woodlawn Eco-precinct. If the methanol option was chosen the liquid fuel could be collected by bulk tanker or used by another manufacturer in the same precinct. The same would apply to the Hydrogen production option; both cement kilns and steel makers are moving to green hydrogen systems and hydrogen can be blended into natural gas supply and hydrogen is a main element in ammonia production.

Fuel from Waste

Apart from incineration of waste for electricity there are other thermal waste processing methods such as: gasification, pyrolysis and torrefaction. Overall, these can be said to involve the extraction of gases from either unsorted or partially sorted MSW including commercial and industrial waste, or gasification of mostly organic material after mechanical separation. Gasification involves heating the material to extract gases in a low to zero oxygen environment to avoid combustion and extract an ideal mix of gases for further specific processes. The resulting gas from gasification of carbonaceous materials (this can be biomass and materials like plastic that are produced from fossil fuel) is largely flammable and can be used as a feedstock for liquid hydrocarbon production like methanol and aviation fuel. Gas to liquid hydrocarbon technology, to convert methane to liquid fuel has been around for a century, its basis that is being constantly improved on is the Fischer-Tropsch (FT) process where settings can determine the length of the hydrocarbons produced, resulting in a range of liquid fuels starting with methane as the initial building block.

Methane is already being produced by municipal waste biodigesters and with genuine interest growing in sectors such as aviation to reduce fossil fuel reliance, liquid fuels produced from the energy embedded in waste could be better directed to substitute for fossil fuel in hard to abate sectors, rather than simply being burnt off onsite for electricity.

Biofuels are increasing in popularity and demand particularly as their emissions are not counted as adding GHGs to the atmosphere as they have come from sources already existing in the biosphere and are not adding to the atmospheric CO_2 load when combusted the way the extraction and combustion of geogenic fossil fuel does. A criticism of large scale bio fuel production is rather than just utilizing green waste (some existing green waste sources are forestry and timber milling, sugar cane harvesting and domestic pruning) it has sometimes required plantations of a monoculture fuel crop displacing native habitat or food crops to ensure a reliable feed stock but it’s not in dispute that the organic fraction of MSW is a large and quantifiable feedstock that must be processed, and can be processed in ways that can attain present day results in a transition to cleaner energy and reducing fossil fuel emissions. Again, there’s not much benefit in the long-term just producing electricity from biomass, compared to supplying the increasing biofuel demand from other sectors.

Heavy transport Industries that are difficult to abate, electrify and move away from fossil fuel reliance such as aviation, can drop biofuel straight into the tank using existing infrastructure and are increasing their demands for biofuel, both from a good citizen perspective and also accessing subsidies. Safe aviation fuel (SAF) starting with biomethane (that can be sourced from scavenged landfill gases or a bioreactor as already exists at Woodlawn Eco) as a building block, has the ‘safe’ designation because the methane is sourced from biomass, like the organic fraction of MSW. NSW EPA, Energy from Waste – Options Paper, “A further option is to have an exclusion for processes that result in a clear environmental benefit (the benefit being subject to criteria in the regulation or guidelines). This could allow other thermal treatment activities – for example, generating sustainable aviation fuel – if they could be shown to produce a clear environmental benefit.” [15]

At a recent aviation conference in Brisbane aviation bosses from multiple airlines were encouraging the production of SAF in Australia due to the fact all aviation fuel is currently being imported and that presents a strategic risk, they also have a strong desire for a good corporate citizen profile by continuing to work on reducing adding carbon from fossil fuels to the atmosphere.

“As a nation we import 100% of our jet fuel, we don’t produce a single drop of it. So if SAF can become a domestic product, that’s also good for jobs and the economy here.” Says, Robert Boyd, Asia Pacific Regional Director for the Boeing company. Ironically some future aviation fuel imports are predicted to be SAF if we don’t begin our own production.

Biomethane is exactly the same chemical compound as fossil sourced methane (CH_4) or ‘natural gas’ and is an alternative fuel, reducing extraction of geogenic methane. Methane from a bioreactor could be sent indirectly to a cement kiln by adding it to existing ‘natural gas’ pipelines or piped directly to a cement plant from a bioreactor situated in the same industrial area such as Port Kembla - until such time as cement kilns take up low/zero emissions energy sources such as renewable electricity or Green Hydrogen. [16] .

Shipping is modifying ship engines and beginning to introduce Ammonia (NH_3) as a zero emissions dual fuel either mixed in with another biofuel such as biodiesel or with standard bunker fuel. The hydrogen in this compound can be sourced from waste and biomass rather than fossil fuel gas. Bunker fuel or heavy fuel oil is a notoriously dirty highly acidic residual substance of crude oil distillation and shipping also regularly takes on a country’s domestic waste oils when they dock in ports around the world.

Developments to clean up GHG emissions from shipping are supported by many governments and international agencies, including the EU and UN [17] The International Maritime Organization (IMO) has developed a plan which if implemented will set a limit, or cap, on how much GHG each shipping company can emit. If they go above the limit they will be levied, in this way lower carbon fuels will be integrated into shipping, as the use of excessive quantities of dirty fuel will attract greater costs than a gradual transition to clean tech fuel. The EU will soon begin a levy on shipping in its waters that do not use a fraction of biofuel. Currently GHG emissions from shipping are not included in any nation's GHG reporting. Therefore it can be seen how methane scavenged from our waste can help reduce emissions by aviation and shipping.

Ammonia has other uses by industry including producing fertilizer (essential for modern agricultural and was in short supply during Covid) and as a liquid organic hydrogen carrier (LOHC) for a variety of other industrial and energy sector uses. Starting with methane which is standard, the production of ammonia requires the splitting of the methane molecule into carbon and hydrogen, the hydrogen is then combined with nitrogen (N) extracted from air and follows the well-established Haber-Bosch (HB) process. This process could be undertaken at the Woodlawn Eco-precinct by changing nothing except shifting to the production of ammonia rather than electricity from the scavenged land fill gases (the bioreactor), perhaps involving a partnership with an ammonia producer.

Higher Temperature Incinerator

A question remains of what to do with the residual waste from the MBT process that really may be in the too hard basket at present? It should be examined closely to determine what products should be banned or modified but there is the option to combust in a very high temperature incinerator/furnace (furnace would be a more indicative name than incinerator) similar in temperatures seen in steelmaking and cement production of ~1500^{0}C, way above the 850^{0}C setting of the Veolia design.

A final combustion chamber would be more expensive, needing to be lined with insulating refractory bricks replaced after 2 to 5 years, depending on operational demands. However, higher temperatures would result in more steam driven electrical energy being exported and arguably a safe return on investment.

Additional fuel would be needed to boost the temperature and hydrogen (H_2) extracted by the pyrolysis of landfill gas or separated out of water by electrolysis powered by renewables, is a possibility to provide that boost. Hydrogen is often criticized as an alternative fuel due to difficult containment and transport costs, however if used in the same industrial precinct as it's produced these issues are avoided. Burning 15% hotter than any fossil fuel hydrogen can easily raise temperatures in a furnace high enough to likely crack the most problematic synthetic compounds back to basic elements. What's described above is an idea that's been borrowed from Green Steelmaking where renewably produced hydrogen is combusted along with iron oxide to make iron, after oxidation the emissions from combusting hydrogen are H_2O as steam. [18]

A very high temperature incinerator/furnace should ideally only be intended to combust the most difficult residue left over from thorough resource recovery of MSW. According to the International Energy Agency, hydrogen can help to decarbonize a variety of sectors, particularly those that are difficult to electrify including heavy industries such as steel. This means that after proper and thorough resource recovery a waste operator such as Veolia should only need to combust a difficult fraction of the MSW stream and be able to do so at much higher temperatures than the 850^0C set out in Veolias EIS for the Woodlawn Eco-precinct incinerator concept.

GHGs

Let's not forget the big issue of GHG emissions from WtE. Estimates are that since around 1750, the beginning of the industrial revolution, there has been up to a trillion tonnes of CO_2 progressively added to the atmosphere that has not yet been captured by the biosphere.

Putting landfill in the sky is only going to cause further climate harm, an example: as heat trapping GHGs slowly warm the planet, sea ice is retreating. Sea ice helps regulate Earth's temperature through something called ice-albedo feedback, where ice reflects the sun's heat back into space. Loss of sea ice means more ocean is exposed to soak up the sun's thermal energy. There are serious issues here, including but not limited to: adverse effects on marine life, rising sea levels and changes to critical ocean currents that will have dramatic flow on effects to land mass temperatures and climate instability.

"We might end up in a new state," says Dr Petra Heil, from the Australian Antarctic Division, "I think a lot of people have the time line too long out, saying this won't affect them. I'm pretty convinced that this is something my generation will experience."

Conclusion

The current proposals for WtE in NSW can result in a brew of poorly combusted, toxic and inadequately deacidified emissions from outdated incinerators and soil enhancing products contaminated with toxic waste. The recent asbestos in Sydney's public spaces mulch event was a specific example of a worsening soil contamination crisis caused by human activity where all manner of toxic substances are being distributed across the landscape.

Large scale combustion of MSW in incinerators to produce electricity may have seemed like a good idea a generation ago however as renewable production of electricity is expanding rapidly to assist in reducing GHG emissions and meet our emissions reduction targets, this rationale is no longer applicable. Also, it's hard to see how incinerating recyclable material after long distance travel is a sustainable or energy saving practice. Emissions from incinerators can emit a wide range of toxins and a similar quantity of GHGs per tonne as fossil fuels and is a backward looking concept for electricity generation.

"Thermal WtE will have higher emissions than landfill in some Australian regions already. This is likely to be the case across the country within ten years, well within the useful life of thermal WtE facilities built today. Beyond this point, the use of thermal WtE would unnecessarily lock in high emissions from the waste sector into the future." [19] FE p37

Thank you for your consideration and I hope this submission is useful to the Inquiry, some final points covered in the submission:

- Indicate why a higher temperature setting for WtE is essential
- A concept for a higher temperature setting
- Producing liquid fuels and other useful chemicals are a better use of the energy embedded in waste than electricity generation
- MSW is continuous and determinable source of recyclable material and feedstock for other uses than electricity generation
- The Good Neighbor Principal applies to the whole of NSW
- Support and apply developments and innovations in waste processing as a matter of course.
- Additional GHGs produced by WtE incineration for electricity (As described by Veolia in its EIS for Woodlawn Eco-precinct) is avoidable.

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