Submission

To	EPA Victoria (via upload)
From	Colin Sweet, CEO Australian Landfill Owners Association
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Subject:	**Draft Guideline for managing greenhouse gas emissions**

Content

Thank you for the opportunity to provide stakeholder feedback Draft Guideline for managing greenhouse gas emissions.

The Australian Landfill Owners Association (ALOA) was formed in late 2008 and is the national body representing landfill owners across Australia. Our primary purpose is work with our members and government to develop and amend legislation that maximises the benefit the community receives in having well located, professionally operated and highly compliant engineered landfills. ALOA is the only Association which is entirely focussed on the landfill industry; an industry that is an essential service to the Community and our membership spans both private industry and local government.

Comments

On the 6 January the EPA published the draft Guideline for managing greenhouse gas emissions. It came about because of an earlier policy statement Victoria's Climate Change Strategy, May 2021. The Guideline is written for businesses large and small to help them manage and hopefully reduce its GHG emissions and an enterprise basis. Landfills are a Scope 1 emitter because it generates methane a powerful greenhouse gas and if this is not controlled, has the potential to affect climate change.

The Victorian government, along with many other state and federal governments, has criticised landfills for many years based on pollution of ground and surface water, loss of recyclable resources and more recently greenhouse gas emissions. It has promoted alternative technologies for waste disposal and currently is promoting mass burn incineration. To assist in this policy, it introduced a landfill levy, now called a waste levy, which has been ramped up over the years to now be $105.90/tonne in metropolitan Melbourne.

However, greenhouse gas emissions have now taken centre stage. In the Climate Change Strategy under waste and Recycling Victoria (a new government body to promote recycling) the following statement has been made.

Recycling Victoria

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> *"Two-thirds of Victoria's emissions from the waste sector result from the decomposition of organic material – such as food and garden waste, paper, cardboard and timber – in landfill. By diverting waste from landfill for recycling, we can cut emissions, reduce air, water and soil pollution and support economic development."*
> *Page 35 Victoria's Climate Change Strategy.*

This statement follows the mantra of all the previous government's statements on greenhouse emissions from landfill, in that landfills are big emitters of greenhouse gases and by default organic wastes, the source of the methane that is a greenhouse gas, should be diverted away from landfills.

This mantra has been refuted on many occasions by the landfill industry, most effectively by the LCA conducted by Hyder in 2010, who that found that for the subject landfill (Hanson's Wollert landfill) it was in fact a greenhouse sink and performed as well, if not better than most of the alternatives in respect to greenhouse gas emissions. The results of the study were presented to the EPA in 2010 and compared to the study conducted for EcoRecycle by Nolan ITU, which underpinned its policy Towards Zero Waste. The difference between the LCA's was that EcoRecycle chose to use low collection efficiency for the methane, whereas the Hyder LCA used the actual collection efficiency achieved at Wollert.

This approach of using low collection efficiencies for methane collection to justify diversion of organics from landfill and the imposition of very high waste levies is a universal approach by governments worldwide. Its latest manifestation is in the Guidelines for introduction of FOGO, published by the MWRRG in which the collection efficiency of 30% is used to justify FOGO's greenhouse gas reduction at the landfill.

Greenhouse gas emissions from landfill

The overwhelming GHG emission from landfills is the fugitive emission of methane from the anaerobic decomposition of organic waste. The rest of the emissions are very minor. Fuel used for operations and landfill construction on a large landfill site is around 1L of diesel per tonne of landfill waste received.

Greenhouse gas generation from landfills has been extensively studied and verified through the National Greenhouse Gas and Energy Reporting Act, which since 2007 has been refined for waste, as for many other sectors of industry. The emissions are simply the amount of methane gas generated minus the amount collected and destroyed, adjusted for oxidation in the surface soils. The amount collected is routinely measured by most large landfills, which have electricity generators using the methane for fuel. The problem is that the models used to calculate the amount of gas generated can get the answer wrong, leading to erroneous figures for methane emissions.

However, serious attempts have been made to measure the methane emissions from landfills and currently all Victorian landfills have a Licence requirement to monitor the concentration of methane at the surface of their landfill. Another measure of methane emissions is simply to use one's nose to detect odours, which are directly linked to the fugitive methane emissions from the broad surfaces of landfills. The results are that it is possible by careful planning and operations to virtually eliminate the emissions of methane from the surface most of the time. Certainly, a well-run landfill with well-timed installation of gas extraction wells can achieve very high collection efficiencies of 90% or more. Achieving this high collection efficiency should be the main approach to meeting the GED for greenhouse gas emissions, rather than diversion into other treatment options. Landfilling is by far the cheapest form of waste disposal and if it is managed well, has a low environmental impact. It does need a lot of space and the right planning controls to be successful.

Renewable Electricity from Landfill Methane

Landfilling has a very low energy profile unlike other waste disposal options. 1L/ tonne of waste received is far lower than any of its alternatives. The methane from landfills has been used since the 1980's and nearly all large landfills receiving organic waste have established electricity generation from the methane. Typically the electricity yield is 150 kWh/tonne of waste received. The only alternative that can produce a greater electricity yield is incineration, due to the fact that the energy is recovered from all the carbon in the waste whereas only 50% of the carbon is used for producing fuel in landfills: the other 50% is emitted a CO_2. Incinerators also burn hydrocarbons in the form of plastics, but these contain fossil carbon from oil.

In Australia hundreds of MW-hs of renewable electricity is generated from landfill methane. The industry was encouraged by several government initiatives such as the Carbon Farming Initiative and the Emissions Reduction Fund. It is privately run by a number of businesses and is highly efficient at extracting and using the methane. Given the right site conditions, these private gas/energy businesses can achieve very high collection efficiencies and current government policies make it financially attractive to do so.

The electricity generated from landfill methane has always been considered renewable since 1990 when the Victorian government set up its first renewable energy scheme. The methane, though a greenhouse gas if emitted, is converted to CO_2 in the engines of the generators. This CO_2 is not fossil carbon but part of the natural carbon cycle and biogenic in nature and not a greenhouse gas. There are some very small quantities of NO_x which do need to be counted as a greenhouse gas.

Apart from control and destruction of landfill methane, the electricity generated substitutes for electricity generated from fossil fuels in the Latrobe Valley. It is fed into the general distribution grid and depending on the circumstances can assist stability in the grid because it is so reliable. Availability of over 95% is the norm.

Carbon Storage

Landfills are the only waste disposal method that can store carbon directly. The degradability of organic carbon in anaerobic environment is restricted by the lignin content. Lignin is very resistant to the methanogenic bacteria that generate methane and can inhibit other organic substances from breaking down by creating an impenetrable barrier. The percentage of total organic carbon that degrades in a reasonable time scale (>100 years) is only about 50%. Timber is the least degraded, but paper products, garden organics and even food waste are all partially undegradable.

As a result landfills store large quantities of organic carbon and are carbon sinks. This is a scientific fact that has been demonstrated time and again by researchers all over the world. It hasn't been accepted in National Greenhouse Gas Inventories until quite recently. The Kyoto Protocol did not recognise it, but after a considerable amount of lobbying from Australia and others, the IPCC has allowed it to be included in National Greenhouse Gas Inventories. In the Australian National Greenhouse Gas Inventory only 90% of the organic carbon in wood and wood waste goes into carbon storage and 50% of the organic carbon in garden waste and paper and paperboard goes into carbon storage.

In the 2019 Refinement of the IPCC 2006 Guidelines, there is a section 12.6 which discusses the long term storage of HWP carbon in landfills (SWDS). This extract confirms that the stored carbon can be deducted from the carbon accounting for HWP.

*When countries explicitly identify the CH_4 emissions and **long stored carbon** originating from disposed wood in SWDS, the carbon contained in these elements may be subtracted from the release of CO_2 from HWP.*

The carbon storage is only for HWP, i.e. solid wood, paper and paper products. It excludes garden waste as this is not accounted for in the AFOLU sector. It could be argued that carbon stored from garden waste should be accounted for in the Waste sector.

In the Australian 2019 Greenhouse Gas Inventory Report the carbon storage in SWDS is calculated in the Waste sector but accounted for in the Forestry sector, as per IPCC guidelines. Most landfill LCA's include carbon storage including the one commissioned by EcoRecycle for the Victorian Government.

Overall greenhouse emissions from landfill

Taking all the discussion above into account with high methane collection efficiency, electricity generation and taking carbon storage into account, a landfill is a strong greenhouse sink. As the collection efficiency increases, the greenhouse sink increases. Diagram 1.1 extracted from the Hyder report shows this clearly. The greater performance of the landfill also benefits other treatment options as there is always a residual that has to be disposed of at landfill conversely a poorly performing landfill will negatively affect the other alternatives.

Figure 1: Hyder Report 2010: Greenhouse gas emissions (Wollert landfill)

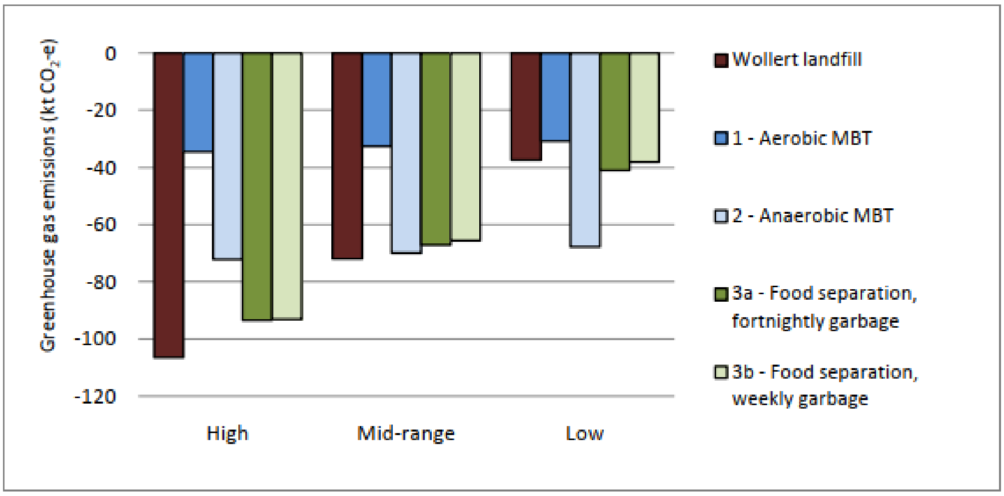


Figure 10 Results with high (88%), mid (74%) and low (60%) range methane recovery rates (using mid-range values for all other parameters, and with assessment using a 100 year instantaneous emissions basis)

Implications for Victoria's Climate Change Strategy.

So clearly if the policy of the government is to reduce greenhouse gas emissions from waste it should be regulating landfills to have the maximum collection efficiency rather than diverting organic waste into other treatment options.

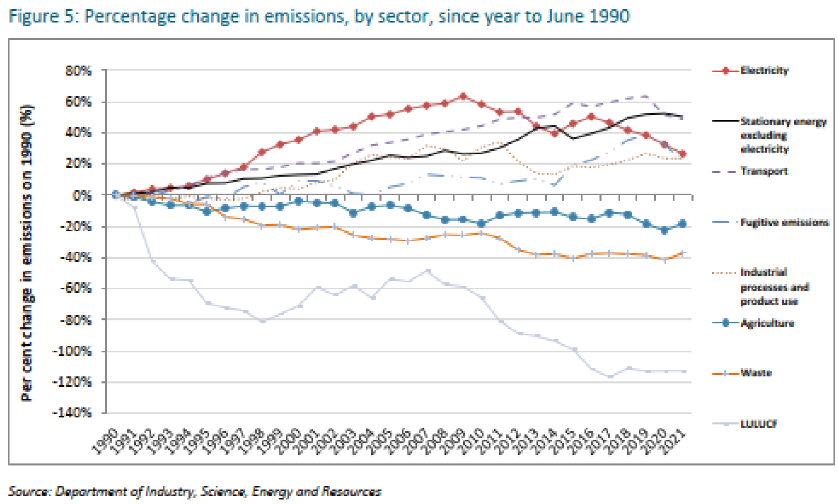
An example of the misguided approach by the government is the Food Organics Garden Organics (FOGO) system for domestic waste. The documents promoting this form of waste diversion use a very low landfill methane collection efficiency of only 30%. If a more reasonable collection efficiency of 70% is used and the loss of renewable electricity offset and loss of carbon storage is taken into account, the greenhouse gas benefits of FOGO are minimal. If the Scope 1 emissions from the composting process and the Scope 2 emissions from the electricity used is taken into account, the greenhouse benefits of FOGO become negative.

The Victorian government is promoting alternatives to landfill for organics that will likely increase greenhouse gas emissions. If it concentrated on getting collection efficiency and utilisation of landfill methane to a higher level it would have a direct and lasting reduction in greenhouse emissions from waste.

Performance of the waste industry in reducing greenhouse gas emissions

Figure 2 shows the truth of the argument. Waste and Agriculture have been the only sectors that have reduced their greenhouse gas emissions consistently since 1990 with waste showing the larger reduction. Waste currently emits 20% less greenhouse gases than it did in 1990 when landfill methane began to be collected for energy recovery. Land clearing reductions have had a bigger impact but that was largely due to favourable conditions under the Kyoto Protocol. The ability of landfills to store carbon and generate renewable electricity in excess of its own requirements would suggest that it should be encouraged not discouraged along with high landfill methane collection efficiency.

Figure 2: Percentage change in emissions by sector



Suggested approach to manage landfill methane

Using the 4 steps detailed in the draft Guideline, the following approach is suggested to manage landfill methane.

Step 1: Identify the GHG emissions sources.

The overwhelming GHG emission source at landfills is the landfill methane emissions from the surface of the landfill. These emissions are a result of the build-up of gas pressure within the landfill as landfill gas is generated by decomposition of the organic waste. Once gas pressure exceeds atmospheric pressure the landfill gas will be released unless there is a gas impermeable barrier or collection system.

Currently BPEM Guidelines issued by the EPA require gas collection and/or membranes in the final cap of a Class 3 landfill, but other forms of capping such a Phytocaps are also possible. It is not possible to have all the waste enclosed in a membrane cap all the time, so without a collection system, the landfill gas will escape from uncapped areas.

The source of GHG emissions from landfills is landfill methane that is not contained or collected. These are commonly known as fugitive emissions and are classified as Scope 1 emissions.

There will be other minor emissions such as from fuel used by earthmoving equipment on site which are Scope 1 emissions. For landfills these will be small compared to the fugitive landfill methane emissions, but they could amount to more than 1,000 tonnes of CO_{2eq} for a large landfill.

Use of electricity on landfill sites will be a Scope 2 emission. If the landfill has a leachate treatment system then a significant amount of electricity will be used for pumping and aeration, so these are GHG emissions on the site.

There will be Scope 3 emissions connected to the landfill such as fuel used by the cars and trucks delivering the waste, but these will be accounted for by others and are beyond the control of the landfill.

Step 2: Assessing the risks from GHG emissions.

Since 2007 the NGER Act has required large landfills to calculate the GHG emissions from fugitive landfill methane and also fuel use. The methods used have been refined over the years and are more accurate than earlier methods. But still the actual generation of landfill methane is uncertain because it is released over a long time and site conditions can vary considerably from the default values. There is the possibility of direct measurement of the emissions under the NGER Act, but it is also difficult to get an accurate measurement from a large non-uniform area.

The two things that can be measured consistently and accurately are the amount of landfill methane collected and the surface concentration of landfill methane. Comparing the amount of methane collected with the theoretical generation rate can give a crude measure of the collection efficiency. Keeping surface methane concentrations to a uniformly low level will ensure there is a low rate of fugitive emission.

Operating landfills are very busy places with new cells being constructed side by side on a regular basis. With new cells, it takes about 1 ½ years before methanogenisis takes hold and landfill methane emissions start. Before that the waste is firstly aerobic and facultative. In the facultative phase the main gas produced is CO_2 and as this is biogenic is not a GHG. Before the 1 ½ years is up, the oldest waste at the bottom of the cell will start to produce landfill methane, but this is oxidised as it passes up through the relatively fresh waste on the surface, which still holds air. When the cell approaches 1 ½ years of age the landfill methane generation becomes so great that it expels the air in the surface waste and fugitive emissions can start. The cross-section of landfill cells is trapezoidal because of the need for side batters, and this creates a flow of gas from old cells into new cells, but as waste builds up on the old batters, the effectiveness of the vertical extraction bores in the old cell increases.

The key risk in methane fugitive emissions is when the cell volume is such that it will not be filled to final level in less than 1 ½ years. The longer it takes to install the extraction wells the more landfill methane fugitive emissions there will be. The peak landfill gas generation time for a Cell is 2-3 years after it is deposited. There is ample evidence that landfills that have built too big cells that take 3 or more years to fill have suffered uncontrollable odour problems, which are directly related to excess fugitive landfill methane emissions.

Step 3: Identify and implement controls to reduce GHG emissions.

The way to reduce GHG emissions from landfills is to collect and destroy the landfill methane either in flares or as fuel for electricity generators or both. Collecting landfill gas is simple but requires the sort of experience that the private landfill gas companies have developed over the years. The objective is to reduce the gas pressure within the landfill to below atmospheric pressure so that the generated gas will move to the extraction bores in preference to the surface. Vertical bores are always more effective than horizontal bores because they are better able to reduce the gas pressure within the landfill. Careful monitoring of the borefield is required to optimise the suction and flow from each bore as they are all different. The aim is to not introduce oxygen into the waste because that could start a fire.

As soon as the cell if filled the vertical gas extraction bores should be drilled and the cell connected to the gas pumping system. There is no need to wait for the final capping to collect the gas, in fact it is a mistake to wait for the final capping. In this manner the peak of landfill methane production will be captured, preventing the bulk of the fugitive landfill methane emissions. Because of the need to batter the edges of the cells to obtain stability, there are large, exposed slopes that are not depressurised by the main borefield. Sacrificial mid slope extraction bores will help minimise the fugitive methane emissions from the batter slopes, as will sacrificial gas impermeable capping on long term batters.

The gas pumping system should be strong enough to exert 1 KPa vacuum at any well in the borefield, though many will be set at much less than that vacuum. If extraction stops for more than a few hours, the landfill methane will escape the surface of the landfill and cause great odour problems as well as GHG emissions. There must be flares in the system that can extract more flow than is being generated, so that should the electricity generators need to shut down the flares can take over. A standalone generator big enough to run the flares should be ready to power the system. When the supply of landfill methane is more than is needed for the electricity generators, the flares will extract the excess.

There will be places that are identified as emitting landfill methane during the surface monitoring. To exert temporary control while permanent solutions are implemented shredded mulch placed on the area that is leaking is effective in controlling the leak by methane oxidation. Typical places where leakage can occur are penetrations in the capping and the edges of the capping and base liner membranes.

The Guideline uses the graphic in Figure 3 to illustrate the hierarchy for controlling the risk of GHG emissions.

Figure 3: Draft Greenhouse guidelines – hierarchy of controlling hazards and risks

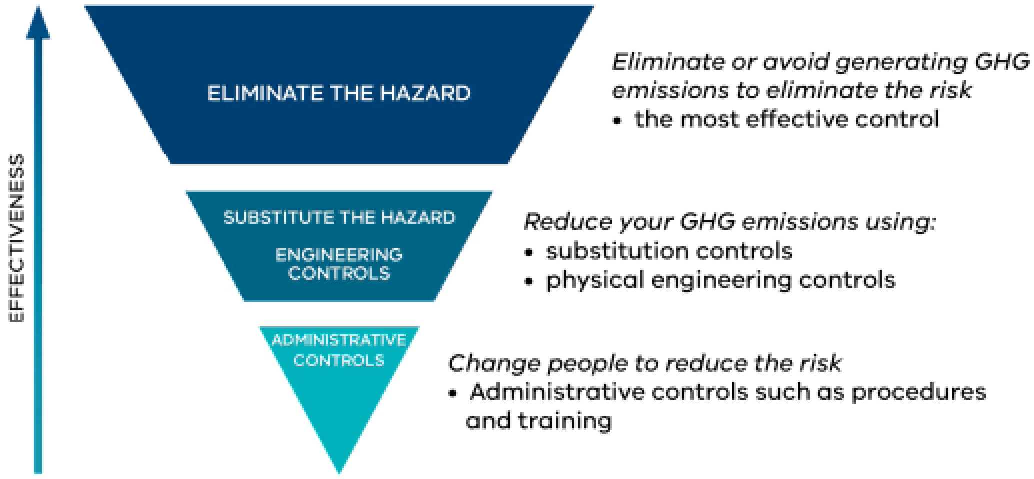


Figure 2: Hierarchy of controlling hazards and risks

The approach suggested in this submission differs from that suggested by the Guideline for the following reasons:

- Eliminating the Hazard i.e., diverting organic wastes from landfill, is not the best approach in this case. It might be the best approach if organic waste can be eliminated from society altogether, but that will not be possible. So with organic waste to deal with, it is suggested in this submission that landfill is the best approach.
- Engineering controls are elevated to the first preference because they can be reliably achieved, as demonstrated by years of experience in the landfill industry. These controls can achieve a better outcome than elimination because of the benefit of carbon storage reducing overall GHG in the atmosphere.
- Administrative control is also preferable to eliminating the hazard in this case. The EPA already have a powerful and effective tool in the regulations to control how landfills deal with landfill methane emissions. Landfills are required to meet stringent surface emission standards. This administrative control alone has transformed the way landfills control fugitive methane emissions. There is a quasi-regulation to control cell size but if this was strengthened with a focus on cell timing and early installation of gas collection bores on the final levels and batters, the performance of gas extraction would be enhanced greatly and therefore GHG emissions reduced significantly.

  Another aspect of administrative control is to continue to support landfill methane used for electricity generation by way of special subsidies or environmental credits. In the past these indirect payments have allowed a strong private landfill gas industry to develop and make efficient landfill methane capture a financial winner for the industry.

Step 4: Review controls to ensure they are effective.

The controls that are most effective are the ones that involve direct measurement of the landfill methane at the extraction system and on the landfill surface. Modelling of generation and calculating collection efficiency indirectly is prone to gross errors.

There should be continuous data on the amount of landfill methane being extracted and this should be examined on a regular basis to ensure consistency in the amount is being collected. The composition of the extracted landfill gas should also be monitored at the extraction pumps and at each bore, so that over extraction and oxygen ingress is avoided.

Surface monitoring of the whole site will identify those areas that need temporary or permanent works to eliminate emissions. If there is a large area that is allowing significant fugitive landfill methane emissions, then it should have extra extraction bores installed. If the area is exposed for a long period, it should be covered by a gas impermeable membrane as well.

The ability to manage upset conditions, such as the grid shutting down the electricity generators, is important and should be subject to practice drills to ensure everyone knows their roles.

One other observation will tell how successful the control system is – the odour. Landfill gas is extremely odorous, and any significant odour detected on site or on the boundary will indicate landfill methane is escaping. The human nose can become desensitised to odour, so it is necessary for an odour assessment to be done after wearing an organic absorption face mask, which will restore the sensitivity of the nose of the wearer.

GHG Emission target.

The guideline includes the setting of a GHG emission target – preferably a reduction in emissions. As discussed above there are great difficulties in measuring volumetric emissions of landfill methane. However, a suggested indirect target is:

- Consistent landfill methane extraction that follows the waste input volumes over time;
- Low or no methane concentrations on the surface of the landfill; and
- Low or no odour detectable at the boundary of the site.

If these targets are met, then the science shows us that the landfill site will be GHG negative and contributing to reduction of GHG in the atmosphere.

We wish to thank the Department for the opportunity to respond and we remain available for further consultation and discussion.

Yours Sincerely

Colin Sweet, CEO