

## INQUIRY INTO ENERGY FROM WASTE FACILITIES

HEARING: 15 December 2025

### SUPPLEMENTARY QUESTIONS FROM MEMBERS

**Dr Jackie Wright, Principal/Director, Environmental Risk Sciences Pty Ltd (enRiskS)**

- 1) In referring to “world-class” or “best practice” EfW facilities internationally, what specific facilities were relied upon in your evidence, and what independently audited, long-term emissions and compliance data was considered in assessing their environmental performance?**

The Joint Research Centre for the European Commission published their most recent review of Best Available Techniques Reference Document for Waste Incineration<sup>1</sup>. There are 38 volumes of Best Available Techniques Reference (BREF) Documents for a wide variety of industries.

The first time a review of best available techniques for waste incineration was published by this group was in 2006. An update of this review commenced in 2014 and was published in 2019. The document from 2019 is more than 700 pages long.

The European Commission formed a forum of relevant government representatives from each member state and these country representatives nominated relevant technical experts to undertake this review. The review made use of data from a wide range of such EfW facilities collected in 2016. This included data from a range of combustion chamber types, a range of waste materials used as feedstock for such facilities and a range of sizes of plants. Small plants were considered to be those that dealt with less than 100,000 tonnes per year of non-hazardous waste. Medium plants were considered to be those that dealt with between 100,000 and 250,000 tonnes per year of non-hazardous waste. Large plants were considered to be those that dealt with more than 250,000 tonnes per year of non-hazardous waste.

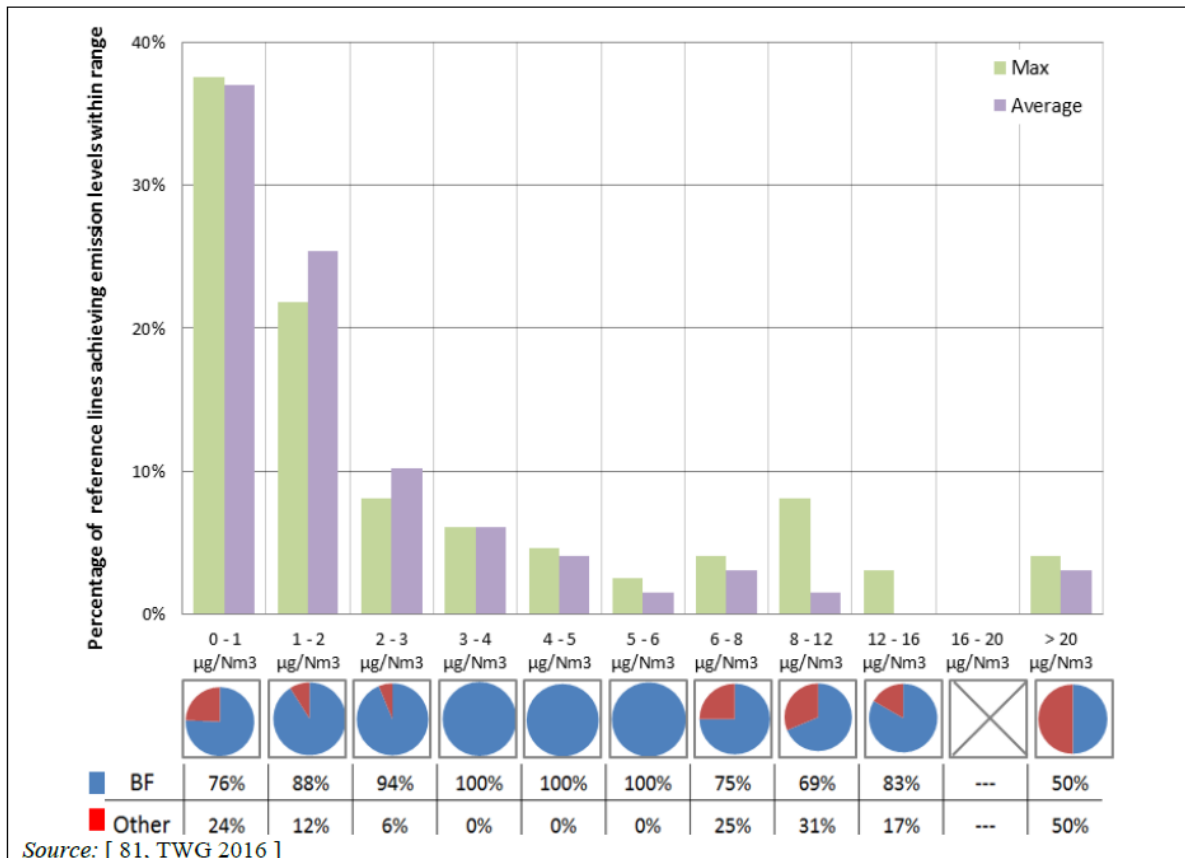
The review looked at the chemical composition of air, bottom ash and air pollution control residues.

Operators were required to identify operating conditions and monitoring data for their facility across an entire year. There were 17,250 half hour average air concentrations in the stacks for each pollutant of interest considered in the review. The dataset provided by the facilities also included related measurements of flow rate, temperature in the combustion chamber, amount of waste fed into the chamber. Overall, there were close to 100 million individual data points in the dataset.

An example of how these data were used is shown in this graph.

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<sup>1</sup> <https://bureau-industrial-transformation.jrc.ec.europa.eu/reference>



**Figure 3.33: Periodically monitored Cd+Tl emissions to air from reference lines incinerating predominantly MSW**

This graph shows that the measured cadmium plus thallium concentrations in the emissions from facilities combusting municipal waste were almost always less than 20 µg/Nm<sup>3</sup>.

This graph is based on the dataset of 17,250 measurements for each pollutant of interest. These measurements came from 197 individual lines. Most facilities will have 1 or 2 individual lines (i.e. 1 or 2 separate combustion chambers and related pollution control equipment). If it is assumed that every plant had 2 lines, then these data came from almost 100 individual plants. In addition, almost half the plants had concentrations in the lowest concentration range.

This detailed and extensive review process conducted by the European Government informs the maximum limits established for the operation of EfW facilities. These limits, or BREF limits, are adopted in NSW as maximum limits for any new EfW facilities.

As a result, air quality modelling for environmental impact statements for the proposed plants in Australia are required to assume that the cadmium+thallium concentrations in air emissions will be at most 20 µg/Nm<sup>3</sup>, which is the BREF emission limit. It can be seen from the graph that about 97% of the lines for which data were available emitted concentrations less than this maximum concentration.

The same process was applied to each pollutant by the team undertaking this work for the European Government. This supports that modern EfW facilities operate at best practice with actual emissions audited to show compliance with the BREF limits.

**2) You referred to the use of incinerator bottom ash from the Kwinana facility for aggregate. At the time that evidence was given, was the Kwinana facility operating under full commercial conditions, and what operational data was available to support its use as a reference facility?**

The Kwinana facility has not yet published data about bottom ash but I have attended conferences where such data have been presented and I have also had personal discussions with the team at Blue Phoenix.

In addition, the Joint Research Centre Best Available Techniques Reference Document for Waste Incineration includes consideration of such data collected across facilities in Europe. This report includes data for bottom ash from 40 EfW plants.

A table indicating the chemical composition of bottom ash derived from municipal solid waste (MSW) EfW facilities is provided and is copied below.

**Table 3.18: Chemical composition of bottom ash from the incineration of MSW**

Values in wt-% Parameter	Bottom ash		
	Min.	Average	Max.
SiO <sub>2</sub>	42.91	49.2	64.84
Fe <sub>2</sub> O <sub>3</sub> *	9.74	12	13.71
CaO*	10.45	15.3	21.77
K <sub>2</sub> O*	0.83	1.05	1.36
TiO <sub>2</sub> *	0.65	1.03	1.33
MnO*	0.06	0.14	0.22
Al <sub>2</sub> O <sub>3</sub> *	6.58	8.5	10.79
P <sub>2</sub> O <sub>5</sub> *	0.55	0.91	1.49
MgO*	1.79	2.69	3.4
Na <sub>2</sub> O*	1.86	4.3	5.81
CO <sub>2</sub>	2.56	5.91	10.96
Sulphates	2.5	15.3	28.3
Chloride	1.3	3.01	7
Cr (ppm)	174	648	1035
Ni (ppm)	55	215	316
Cu (ppm)	935	2 151	640
Zn (ppm)	1 200	2 383	4001
Pb (ppm)	497	1 655	3245
NB: * These values are calculated based on X-ray fluorescence analysis. Source: [ 82, Germany 2014 ]			

Most of these parameters are just minerals that are commonly present in soil and rocks.

Like all outputs from industrial processes, such materials would be required to be tested and analysed for a range of chemicals, including metals, dioxin-like compounds and other organics. Such testing would be used to determine appropriate waste disposal in accordance with NSW waste regulations. Should the material be suitable for reuse, which is a desirable outcome to maximise waste minimisation, in NSW a resource recovery order and exemption would need to be applied for from the EPA. Note that there are current resource recovery orders available for coal ash, ash from burning biomass and slag (from various sources) – all of which are from various existing combustion/incineration processes.

**3) What evidence is relied upon to assess whether the operational, regulatory and environmental performance of facilities such as Kwinana is transferable to the proposed EfW facilities at Parkes and Tarago, given differences in waste composition, scale, regulatory settings and surrounding land use?**

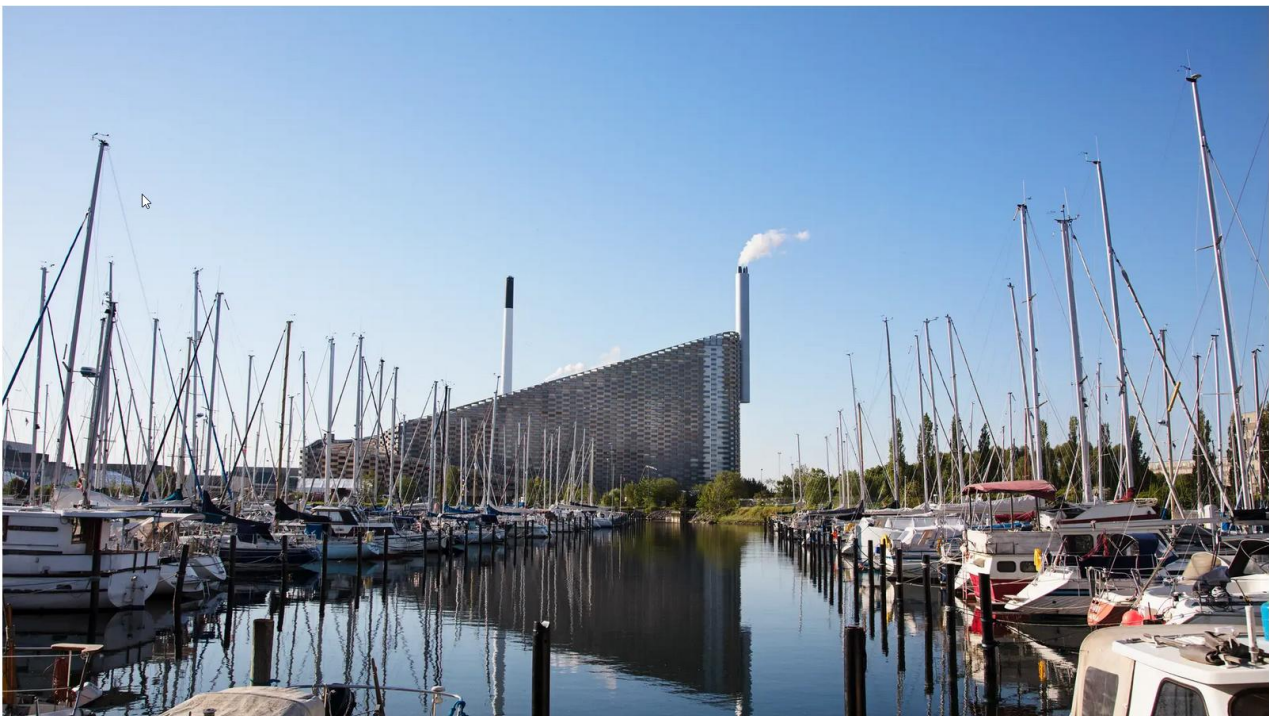
The Joint Research Centre Best Available Techniques Reference Document for Waste Incineration includes consideration of data from 100-200 facilities. The regulatory stack concentrations required by the legislation in Europe are the worst-case measured concentrations based on facilities with best practice equipment.

This means air quality modelling used in the environmental impact assessments for the various facilities across Australia based on these regulatory stack concentrations will definitely be transferable as they cover differences in waste composition, scale and surrounding land use.

In most cases in Australia, proponents of waste to energy facilities have chosen sites that are at least 1 km from residential areas or agricultural areas.

Many plants in Europe are much closer to such areas – some examples include:

**Denmark:** An EfW facility in Denmark is located in the centre of Copenhagen. It is located around 250 m from residential areas, less than that to industrial areas and around 1.5 km to the Palace for the Danish monarchy. The facility is shown in the photo below



**Dublin:** There is also an EfW in Dublin that is close to urban and residential areas. The facility is shown in the photo below. It is located within an industrial area but is less than 1 km from existing and being constructed residential areas.



**Major cities:** Such plants are also located in the centre of Paris, London and major cities in Japan (Tokyo and Osaka for example). The photos below show the London Energy facility and one of the EfW facilities in Tokyo. The London facility is being upgraded to meet the most recent regulatory requirements. This is an image of the newer plant which is being constructed next to the older one. The older facility was constructed in 1969. This means there has been waste incineration occurring in this part of London for more than 50 years.



London



Tokyo – Minato EfW plant

The Tokyo plant is located in a densely populated area and has also been recently refurbished/updated to extend the life of the facility.

In addition to the above EfW facilities have been co-located in many agricultural areas in Europe. Examples include:

- Couëron Waste Treatment and Recovery Centre located in Greater Nantes with a range of agricultural (and residential) land surrounding the facility
- VALAUBIA – Unité de valorisation énergétique des déchets facility in La Chapelle-Saint-Luc where agricultural land is located 500 m from the facility
- Energy Valorization facility in Rennes Metropole (<https://www.uve-rennesmetropole.fr/>) which is located in an agricultural area of France, noting the Brittany area of France (which includes Rennes) has the highest number of dairy farms in France (10,732 reported in 2018<sup>2</sup>)
- Remival<sup>3</sup> is located in the Champagne region of France, in the municipality of Reims. This facility is in close proximity to many famous vineyards. The EfW facility has been operating for more than 20 years.

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<sup>2</sup> [https://www.statista.com/statistics/1198763/number-cow-milk-holdings-by-region-france/?\\_sso\\_cookie\\_checker=failed](https://www.statista.com/statistics/1198763/number-cow-milk-holdings-by-region-france/?_sso_cookie_checker=failed)

<sup>3</sup> <https://www.recyclage.veolia.fr/nous-trouver/unite-valorisation-energetique-remival-reims-51>

**4) Evidence presented stated that emissions from EfW facilities would not result in “measurable changes” to background levels of pollutants. What analytical detection limits and statistical thresholds were relied upon in reaching that conclusion, and how do those limits compare with concentrations relevant to agricultural or food-production settings?**

Air quality modelling allows the calculation of changes in concentrations of pollutants in air even if they are too small to be noticeable or measurable. This is because the modelling is based on mathematical calculations.

To illustrate how small modelled concentrations from air quality modelling for an EfW facility are a comparison of modelled ground level concentrations from a range of facilities with measured concentrations in air in Australia in a study by NSW EPA is appropriate (NSW DEC 2003, 2004b, 2004a; NSW EPA 2003).

The NSW EPA study measured metals, PAHs and dioxin-like compounds in air in a number of locations around Sydney, Newcastle and Wollongong and in some more remote NSW locations for some chemicals (NSW DEC 2003, 2004b, 2004a; NSW EPA 2003). This study was undertaken to provide a baseline for the levels of these chemicals in urban air in NSW.

The locations that were monitored for many of the metals, PAHs and dioxin-like compounds included:

- Metals (samples collected over 24 hours on each occasion)
  - Sydney – Blacktown, Earlwood, Richmond and Rozelle
  - Newcastle – CBD
  - Illawarra – Albion Park and CBD
- Dioxin-like compounds (samples collected using high volume sampler over 12 days for the urban areas and 24 days at Siding Spring – each sample required sampling for these extended periods)
  - Sydney – Westmead
  - Wollongong – Warrawong
  - Regional/remote area – Siding Spring Observatory
- PAHs (samples collected over 24 hours on each occasion)
  - Sydney – CBD, Rozelle, Earlwood, Blacktown, Richmond, Lindfield
  - Newcastle – CBD, Wallsend, Beresfield
  - Wollongong – CBD, Albion Park, Warrawong, Kembla Grange, Kembla Street, Wattle Street and Military Road
  - Regional areas – Orange, Lithgow, Tumut, Cooma, Nowra and Armidale

Average concentrations reported for each of the pollutants measured in the NSW EPA study (the ones relevant for an energy from waste facility) at the various location types monitored by NSW EPA are listed in the table below.

These are the concentrations that are already in air in urban areas now.

These chemicals are in air in urban areas from natural sources (e.g. windblown dust that contains metals from weathering of rocks etc or bushfires) and from human activities (e.g. vehicle emissions, wood fired heaters, cooking (gas), power stations, etc).

## Average ground level concentrations reported in NSW EPA monitoring

Pollutants	Average concentrations ( $\mu\text{g}/\text{m}^3$ )			
	Sydney	Newcastle	Wollongong	Regional/remote
Cadmium	0.06-0.28	0.41	0.04-0.11	NA
Thallium	NA	NA	NA	NA
Mercury	NA	NA	NA	NA
Antimony	0.1-2.2	2.8	0.22-0.28	NA
Arsenic	0.4-1.3	0.84	0.18-0.22	NA
Lead	8.9-68	30	3.4-24	NA
Chromium (as VI)	NA	NA	NA	NA
Cobalt	0.13-0.26	0.12	0.1	NA
Copper	3.9-22	6.2	3.1-4.9	NA
Manganese	4.4-7.4	66	4.6-5.9	NA
Nickel	0.95-6.2	1.6	ND	NA
Vanadium	0.26-13	1	0.48-0.66	NA
PAHs as BaP <sup>1</sup>	0.00003-0.00046	0.00003-0.00016	0.00006-0.0003	0.00002-0.0042
Dioxin-like compounds	0.000000014	NA	0.00000001	0.0000000064

### Notes:

- 1 range reported is average concentration in summer and in winter – concentrations of PAHs in winter are higher than in summer due to the use of wood fired heating
- NA no sampling was undertaken at this type of location
- ND not detected above the limit of reporting

Predicted ground level concentrations from air quality modelling for a range of EfW facilities are compared to the concentrations measured by NSW EPA is provided in the table below.

### Comparison of concentrations reported in NSW EPA monitoring with those for various proposed energy from waste facilities

Pollutants	Concentrations ( $\mu\text{g}/\text{m}^3$ )		Fraction contributed by EfW facilities
	NSW EPA data – existing urban air	Annual average – maximum predicted ground level from EfW	
Cadmium	0.04-0.41	0.00002-0.00008	0.0002
Antimony	0.1-2.8	0.00004-0.0001	0.00001
Arsenic	0.18-1.3	0.00002-0.00006	0.00002
Lead	3.4-68	0.0002-0.0008	0.00005
Chromium (Cr VI assumed)	--	0.00005-0.00009	
Cobalt	0.1-0.26	0.00001-0.00005	0.00004
Copper	3.1-22	0.00005-0.0002	0.00002
Manganese	4.4-66	0.00008-0.0003	0.00002
Mercury	--	0.00004-0.00008	
Nickel	0.95-6.2	0.00006-0.0002	0.00001
Vanadium	0.26-13	0.000007-0.00003	0.00003
PAHs as BaP	0.00003-0.0042	0.0000000004-0.000001	0.0002
Dioxin-like compounds	0.000000014	0.0000000001-0.0000000004	0.007

These comparisons show that the concentrations at ground level are more than 100 times lower than what is already in urban air. In most cases, the ground level concentrations are more than 50,000 times lower than what is already in urban air.

In addition, the predicted concentrations from EfW facilities are below the relevant reporting limits for analysis of metals, PAHs and dioxin-like compounds in air (i.e. below what a laboratory can measure).

This means that emissions from such a facility will make no noticeable change in the concentrations of these chemicals in air.

Similar comparisons have also been done for the modelled impacts or changes in concentrations in rainwater tanks and even produce – for example as presented in Appendix P of the EIS<sup>4</sup> for the Woodlawn Advanced Energy Recovery Centre: Human health Risk Assessment.

For the maximum concentrations that were predicted in rainwater tanks (regulatory scenario which is the emission limits expected at the time of the EIS), these are presented in the following table extracted from Appendix P of the EIS. Note that the calculations include emissions from other sources in the Woodlawn Eco Precinct – so not just the proposed EfW facility. The table includes the drinking water guideline (applicable at the time of the EIS) – which shows predicted concentrations from the EfW facility are a very small fraction of the guideline.

**Table 4.14: Summary and review of exposures to chemicals in drinking water – Scenario 3: NSW EfW regulatory emissions (maximum sensitive receptor, ARC + existing sources)**

Persistent and bioaccumulative chemical	Calculated maximum concentration in rainwater tanks (mg/L)		Drinking water guideline (mg/L)	HI (ratio of dissolved concentration to drinking water guideline)
	Dissolved – relevant to exposure	Total (particulate and dissolved) – highly conservative (assumes sediment is stirred up in tank)		
Antimony	5.6 x 10 <sup>-7</sup>	1.3 x 10 <sup>-5</sup>	0.003 <sup>A</sup>	0.00019
Arsenic	8.2 x 10 <sup>-7</sup>	1.3 x 10 <sup>-5</sup>	0.01 <sup>A</sup>	0.000082
Beryllium	7.4 x 10 <sup>-10</sup>	2.9 x 10 <sup>-7</sup>	0.06 <sup>A</sup>	1.2 x 10 <sup>-8</sup>
Cadmium	1.5 x 10 <sup>-7</sup>	5.6 x 10 <sup>-8</sup>	0.002 <sup>A</sup>	0.000073
Chromium (Cr VI assumed)	3.0 x 10 <sup>-11</sup>	2.7 x 10 <sup>-5</sup>	0.05 <sup>A</sup>	6.0 x 10 <sup>-10</sup>
Copper	1.6 x 10 <sup>-7</sup>	3.0 x 10 <sup>-8</sup>	2 <sup>A</sup>	8.2 x 10 <sup>-8</sup>
Cobalt	7.2 x 10 <sup>-8</sup>	1.7 x 10 <sup>-4</sup>	0.006 <sup>U</sup>	0.0012
Lead	5.4 x 10 <sup>-7</sup>	2.4 x 10 <sup>-4</sup>	0.01 <sup>A</sup>	0.000054
Manganese	8.0 x 10 <sup>-7</sup>	2.7 x 10 <sup>-5</sup>	0.5 <sup>A</sup>	0.0000016
Mercury	2.7 x 10 <sup>-7</sup>	7.3 x 10 <sup>-8</sup>	0.001 <sup>A</sup>	0.00027
Nickel	7.9 x 10 <sup>-7</sup>	2.6 x 10 <sup>-5</sup>	0.02 <sup>A</sup>	0.000039
Thallium	8.4 x 10 <sup>-8</sup>	3.1 x 10 <sup>-8</sup>	0.0002 <sup>U</sup>	0.00042
Vanadium	1.2 x 10 <sup>-8</sup>	6.0 x 10 <sup>-8</sup>	0.086 <sup>U</sup>	1.4 x 10 <sup>-7</sup>
Zinc	1.8 x 10 <sup>-5</sup>	5.7 x 10 <sup>-4</sup>	6 <sup>U</sup>	3.0 x 10 <sup>-8</sup>
Dioxins and furans (WHO-TEQ)	1.7 x 10 <sup>-20</sup>	5.3 x 10 <sup>-12</sup>	1.6 x 10 <sup>-8</sup> <sup>A</sup>	1.1 x 10 <sup>-12</sup>
			<b>Total HI</b>	<b>0.0023</b>
			<b>Acceptable/negligible HI</b>	<b>≤1</b>

Refer to **Appendix C and E** for the methodology, assumptions and calculation of water concentrations

A = Australian Drinking Water Guidelines (NHMRC 2011 updated 2022), with the exception of dioxins (including dioxin-like PCBs) where the drinking water guideline in the recycled water guidelines has been adopted (NRMMC 2008)

U = Residential tap water guideline from USEPA Regional Screening Levels (USEPA 2022)

Where water samples are collected from a rainwater tank (or other water source) for the purpose of analysis, an analytical limit of reporting (LOR)<sup>5</sup> applies to the results, as follows:

- For metals, the LOR is commonly around 0.001 mg/L, with trace analysis reporting a LOR in the range of 0.0001 to 0.0005 mg/L with cadmium reported to a LOR of 0.00005 mg/L. All concentrations of metals calculated in rainwater tanks are below these analytical LORs, and hence these chemicals would not be detected where water sampling occurred.
- For PAHs, the LOR is commonly around 0.00002 mg/L, with trace analysis reporting a LOR around 0.000005 mg/L. The concentration of PAHs calculated in rainwater tanks are well

<sup>4</sup> <https://www.planningportal.nsw.gov.au/major-projects/projects/woodlawn-advanced-energy-recovery-centre>

<sup>5</sup> Limit of reporting (LOR) for chemical parameters is the minimum concentration of a substance in a sample that can be reliably detected by a laboratory. This will depend on the type of sample analysed and the methodology used by the laboratory. Where reported as not detected, this means that the concentration in the sample analysed is lower than the LOR that can be achieved by the laboratory.

below the analytical LORs, and hence these chemicals would not be detected where water sampling occurred.

- For dioxins and furans (including dioxin-like PCBs), the LOR can be variable between laboratories, however, it is typically around 4 to 5 pg/L (or 4 to 5 x 10<sup>-9</sup> mg/L) as an upper limit (i.e. using the LOR for all individual congeners) WHO<sub>05</sub>TEQ. The concentration of dioxins and furans, and dioxin-like PCBs calculated in rainwater tanks are well below the analytical LOR, and hence these chemicals would not be detected where water sampling occurred.

For the maximum concentration that were predicted in grain crops, these are presented in the following table extracted from Appendix P of the EIS. The concentrations in grains calculated in the table is based on a worst-case where metals and organics have accumulated in soil from the operation of the EfW facility continually for 70 years, and then grain crops are grown in that soil. The table includes the Maximum Limits for food crops set by Food Standards and typical values in similar products in Australia. Also note that the calculations include emissions from other sources in the Woodlawn Eco Precinct – so not just the proposed EfW facility.

**Table 4.15: Review of concentrations in grain (and similar) crops – maximum sensitive receptor (ARC + existing sources)**

Pollutant	Estimated maximum concentration in grain (mg/kg)		Food Standards Code – ML for cereals, grains, wheat etc or equivalent (mg/kg)	Range of mean concentrations reported in cereal products evaluated in dietary surveys in Australia (mg/kg)
	Scenario 2: Reference case maximum emissions	Scenario 3: NSW EfW regulatory emissions		
Antimony	0.000097	0.00052	--	0.003 (F5)
Arsenic	0.00033	0.00043	1	--
Beryllium	0.00000023	0.00000081	--	NA
Cadmium	0.0011	0.0027	0.1	--
Chromium (Cr VI assumed)	0.000046	0.00017	--	0.015 to 0.13 (F3)
Copper	0.000097	0.00098	--	0.67 to 4.1 (F3)
Cobalt	0.00069	0.00083	--	0.0054 to 0.071 (F3)
Lead	0.0014	0.0016	0.2	--
Manganese	0.0016	0.011	--	6.7 to 35 (F3)
Mercury	0.000044	0.00083	--	0.005 (F2)
Nickel	0.000053	0.00035	--	0.212 to 0.41 (F4)
Thallium	0.00000075	0.000016	--	NA
Vanadium	0.0000013	0.000011	--	NA
Zinc	0.049	0.076	--	4.5 to 38 (F3)
PAHs (as BaP)	5.3 x 10 <sup>-9</sup>	--	0.001 <sup>E</sup>	--
Dioxins and furans (WHO-TEQ)	2.2 x 10 <sup>-12</sup>	3.8 x 10 <sup>-12</sup>	--	1 x 10 <sup>-8</sup> to 4 x 10 <sup>-8</sup> (F1)
Dioxin-like PCBs (WHO-TEQ)	4.7 x 10 <sup>-13</sup>	--	--	

E = Maximum limit for cereal products from the EU <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex:32006R1881>

F = Food Standards Australian Total Diet Surveys

<https://www.foodstandards.gov.au/science/surveillance/Pages/australiantotaldiets1914.aspx>

F1 = 26<sup>th</sup> Diet Survey (2020)

F2= 25<sup>th</sup> Diet Survey (2019)

F3 = 23<sup>rd</sup> Diet Survey (2011)

F4 = 22<sup>nd</sup> Diet Survey (2008)

F5 = 20<sup>th</sup> Diet Survey (2003)

The LORs for the analysis of food products vary depending on the chemical and the type of food product being evaluated. For most foods analysed (as reported by FSANZ), the LOR is as follows:

- Metals have a LOR typically around 0.005 to 0.01 mg/kg. Concentrations of most metals predicted in crops are lower than these LORs and hence would not be measurable. In relation to zinc, the predicted concentrations in grain crops are just above the analytical LOR, and while these levels may be measurable, they are only a very small proportion of the concentrations typically reported in grain products grown in Australia and would not result in any discernible change in the quality of produce derived from the local area. In addition, zinc is a metal that is an essential micronutrient – i.e. zinc is required for the normal operation of the body.
- Dioxins and furans have a LOR typically around  $1$  to  $2 \times 10^{-7}$  mg/kg. All concentrations of dioxin-like compounds predicted in crops are well below than these LORs and hence would not be measurable.

The above are consistent with the outcomes of assessing emissions from many other proposed EFV facilities in Australia.

**5) Where pollutants such as metals, dioxins or PFAS are described as being present at background levels, what methods are used to distinguish incremental contributions from a new EfW facility versus existing sources over time?**

As shown in the discussion above, the concentrations emitted from these facilities are so small as to not be measurable compared to what already exists in the air in urban and rural areas. We are all exposed to these chemicals every day from many sources. They do not just come from this type of facility. In fact, higher levels leach out of landfills. Regardless, air quality modelling allows calculations of the very small incremental contributions these facilities make to urban or rural air.

Metals are naturally derived from the earth's crust and are variable within soil throughout various regions in Australia. In addition, metals are also present in many products applied to land including fertilisers, compost, manure and animal feed.

Dioxin-like compounds are present in soil arising from bushfires, burning of biomass in agricultural settings and pesticides. Hence in agricultural areas, dioxin-like compounds are present in soil and would be variable depending on the location. Dioxin-like compounds are also derived from other industrial sources and landfills<sup>6</sup>.

PFAS, while man-made chemicals, have been present throughout a wide range of consumer products and materials for decades. As a result, there are low levels of PFAS in the environment, and in landfills<sup>7</sup>.

As the impacts or changes in concentrations from the operation of an EfW facility are not measurable, it is not appropriate to try to measure changes within the environment – as the small changes would not be able to be discerned from background and the variability in background. The most appropriate place to measure chemicals in emissions to air from any industrial facility, including EfW is in the stack. This is where measurements relate only to emissions from the EfW facility and the concentrations are expected to be at levels that can be measured using approved methods – so the data are reliable.

It is also noted that we have enHealth guidance (i.e. national guidance from Australian health departments) on how to assess these very small increments to determine if they could have any impact on health for those living and working around such proposed facilities.

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<sup>6</sup> <https://www.nepc.gov.au/sites/default/files/2022-09/dioxins-and-dioxin-compounds-soil-technical-memorandum.pdf>

<sup>7</sup> <https://www.dcceew.gov.au/about/initiatives/pfas>

**6) How are cumulative exposures across multiple pathways - including air deposition, soil uptake, agricultural produce and water - intended to be addressed, particularly in regional or agricultural settings?**

enRiskS has been undertaking assessments of these types of facilities for the last decade. Our assessments are undertaken in accordance with Australian guidance and also consider the detailed guidance from the USEPA<sup>8</sup> about how to do such assessments for hazardous waste combustion (even though be applied to non-hazardous waste combustion here in Australia – so conservative guidance). This guidance provides details about how to assess risks to community health based on:

- concentrations in air that people might be inhaled
- deposition of particles onto soil or dust inside a home where people might come into contact with the soil when gardening (for example) and the dust when at home
- uptake into fruit, vegetables, eggs, meat or milk produced in areas where such deposition to soil might have occurred – and consumption of these produce
- deposition of particles onto a roof that might get washed into a rainwater tank used for drinking water.

All of these exposure scenarios have been considered in the assessments undertaken by enRiskS for these types of facilities. Similar assessments have also been undertaken by enRiskS for a range of other types of industrial facilities not just waste to energy facilities.

In addition, the potential for other types of exposure have been added into our assessments where required in specific locations.

Multi-pathway exposure assessment is a process that enRiskS are well experienced in applying.

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<sup>8</sup>  
<https://nepis.epa.gov/Exe/ZyNET.exe/P10067PR.TXT?ZyActionD=ZyDocument&Client=EPA&Index=2000+Thru+2005&Docs=&Query=&Time=&EndTime=&SearchMethod=1&TocRestrict=n&Toc=&TocEntry=&QField=&QFieldYear=&QFieldMonth=&QFieldDay=&IntQFieldOp=0&ExtQFieldOp=0&XmlQuery=&File=D%3A%5Czyfiles%5CIndex%20Data%5C00thru05%5CTxt%5C0000022%5CP10067PR.txt&Use r=ANONYMOUS&Password=anonymous&SortMethod=h%7C- &MaximumDocuments=1&FuzzyDegree=0&ImageQuality=r75g8/r75g8/x150y150q16/i425&Display=hpfr&DefSeekPage=x&SearchBack= ZyActionL&Back=ZyActionS&BackDesc=Results%20page&MaximumPages=1&ZyEntry=1&SeekPage=x&ZyPURL>

## **7) How does your risk assessment framework account for uncertainty where empirical data is limited or unavailable, particularly for emerging contaminants or long-term, low-dose exposure scenarios?**

As with all risk assessments – those used for contaminated sites, all types of industrial facilities, environmental impact assessments etc – it is acknowledged that uncertainty will always be present.

Guidance on how to deal with uncertainty and variability is embedded in all national and international documents from reputable organisations like WHO, USEPA<sup>9</sup> etc.

This is because it is not possible to measure all the soil at a contaminated site (there would be none left) or to measure air emissions from a facility that is not yet built or to understand how wind blows every minute of the day.

As a result, the risk assessment framework always understands that there is both uncertainty (things we could clarify with more measurements if that is possible) and variability (things like wind direction, wind speed, body weight of a person, how long a person might live at a site etc – things that are always varying and more measurements do not help).

When we are assessing potential exposures and risks to human health, whenever there is any uncertainty, the approach adopted is to make a conservative assumption. This will always result in an overestimation of actual exposure and risk. This approach is consistent with Australian and International guidance to ensure that assessments of human health do not underestimate risk.

Therefore, assumptions adopted for assessing risks to human health are based on worst case possibilities. For example:

- for a contaminated site, it is usual to use:
  - the maximum concentration of a chemical measured in soil at a site
  - that people live and spend time at their homes 365 days per year and 20-24 hours a day
  - that people spend time at their workplace 8 or 10 hours a day for 240 days per year (i.e. every work day of the year – i.e. no weekends and 4 weeks annual leave)
- for an EfW facility, it is usual to use:
  - the maximum legally allowed stack concentration (i.e. the value from BREF etc) as the basis for the modelling or emissions to air
  - calculating potential risks at the residential location where the maximum concentrations in air and maximum dust deposition rate is predicted from the air modelling – assuming people are always present at that location
  - that people live and spend time at their homes 365 days per year and 20-24 hours a day
  - that people spend time at their workplace 8 or 10 hours a day for 240 days per year (i.e. every work day of the year – i.e. no weekends and 4 weeks annual leave)
  - emissions from the EfW facility continually occur and can accumulate over 25 to 70 years (depending on the expected life of the facility) with no cleaning of the accumulated dust in a home and no changes to gardens such as adding mulch, fertilisers, topsoil etc at any time.

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<sup>9</sup> <https://www.who.int/publications/i/item/9789241513548> or <https://www.who.int/publications/i/item/9241562676> or <https://www.who.int/publications/i/item/9789240035720>

All the parameter values used in these assessments are either based on government agreed values presented in national guidance or are justified in detail within an assessment using appropriate international guidance or information from the scientific literature.

Using these worst case values for the risk calculations means the risk estimates are overestimates of likely risks. This means if the risk estimates are compliant with national requirements and they are overestimates for the situation then the realistic situation will definitely be compliant with national guidance.

This process has been part of risk assessment framework since the USEPA first put the process together in the 1980s.

**8) Environmental Risk Sciences' written submission to the inquiry states that the technology to measure certain parameters on a continuous basis, outside combustion and criteria pollutants, does not exist (p.12). On what basis does enRiskS make this claim?**

**a. What consideration was given to updated European Best Available Techniques which require continuous mercury monitoring?**

All waste to energy facilities constructed to comply with European best available technologies requirements<sup>10</sup> (i.e. BREF) include continuous monitoring for a wide range of parameters such as:

- temperature in the combustion chamber
- oxygen content in the combustion chamber
- pressure in the combustion chamber
- water vapour levels in the waste gas
- waste flow rates across the grate
- parameters relevant to production of electricity
- parameters relevant to ensuring the air pollution control equipment are all working optimally (whether bags in the baghouse need replacing, whether activated carbon is being delivered into the gas flow at the appropriate location and rate etc).

Monitoring all of these parameters allows the plant operators to be aware if conditions are changing inappropriately. The alarms built into the operating systems mean any such changes cannot be ignored.

BREF also requires continuous monitoring for total dust, hydrogen chloride, hydrogen fluoride, nitrogen oxides, sulfur dioxide, carbon monoxide and total organic carbon to back up the findings of the operating condition monitors and to show that these major pollutants are being removed from the gases to the expected extent. This means that the minor pollutants like metals and dioxins will also be removed to the expected extent in line with the planning documents.

BREF includes clauses about the EU adopting continuous monitoring for metals and dioxins/furans when they become feasible (Clause 40 in the initial section; Clause 5 in Article 48) – i.e. acknowledging that they cannot require these pollutants to be measured on a continuous basis yet because the technology does not currently exist. The regulation, however, is worded in a way that allows such requirements to be introduced in the future if such technology becomes available.

Requirements in BREF for monitoring of mercury are based on the same type of sampling as is required for other metals or dioxins. Mercury is to be measured in a sample taken from the stack collected for between 30 minutes and 8 hours. The sample collected in this way is then taken to a laboratory for analysis.

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<sup>10</sup> <https://bureau-industrial-transformation.jrc.ec.europa.eu/reference>