

Determining the ACT Eligible Container Factors

The ACT MRF protocol states that the eligible container factor for each output material will be calculated from sample data obtained in accordance with the sampling plan approved by Waste Manager.

Factors are determined quarterly. The sampling plan calls for random samples of material outputs be taken at the ACT materials recovery facility (MRF) prior to bailing for:

- Aluminium;
- PET
- HDPE; and
- Mixed plastics.

Due to the high percentage of glass that is broken during collection and processing, and the consequent difficulties in counting eligible containers, the factor for glass is to be determined from kerbside input samples taken from household recycling bins.

For the input and output samples:

- The sample statistic is the average count of eligible containers per kilogram; and
- The samples are to be representative of the materials processed for claiming against the CDS by the ACT MRF over the course of the quarter (the population).

The MRF output samples are all taken on a volumetric basis with a standard size of 1,000 litres. The sampling plan calls for samples to be stratified over the two-week ACT collection schedule to ensure the samples are as representative of eligible materials recycled in the ACT. Therefore, the samples can, for the most part, be treated as self-weighting and the factor calculated as an unweighted sample mean.

The standard error of the factor is the sample standard deviation divided by the square root of the sample size and the relative standard error (RSE) of the factor is the mean divided by the standard error of the mean. Multiplying the RSE by two gives a conservative estimate (overstatement) of the error margin at the 95 per cent confidence level.

Misclassified eligible materials (i.e. found within the wrong stream sample) were considered contaminants and excluded from the counts. Eligible mixed plastics were a mix of PET and HDPE.

Coloured and natural HDPE were sampled separately as set out in the sampling plan which was prepared prior to the finalisation of the ACT Container Deposit Scheme Processing Refund Protocol. The issued protocol called only for a single HDPE factor. The two samples appended need to be aggregated and weighted according to throughput of each material. While the nominal sample size is doubled the effective sample size is still equal to original sample size of each of the two materials.

The weighted factor means, standard deviations and RSEs are calculated using the open source statistical programming language 'R'. The weighted standard deviations are calculated using the 'radiant.data' package. The proportion of each at the ACT MRF between April 18, 2017 to April 18, 2018 was used to weight coloured and natural HDPE. The weights were: Coloured = 0.36, Natural = 0.64

Glass Factor Calculation

The sampling unit for the kerbside survey was an ACT suburb (ABS statistical area 2). The number of sampling units was set by the ACT government at 20. The target number of households for each sample was 50.

The kerbside samples were stratified by suburb to ensure a more representative sample and increase the efficiency of the sampling (greater accuracy for a given sample size). The stratification was done using data from the ABS 2016 census unless otherwise noted:

- Single versus multiple dwellings (sourced from the ACT government);
- Household income;
- Number of households; and
- Persons per dwelling

Cluster analysis was used to classify suburbs into three strata, with the following rough characteristics:

- Mostly single dwellings, more households and lower household income;
- Mostly single dwellings, fewer households and higher household income; and
- Mostly multiple dwellings and fewer persons per dwelling.

A total of 20 sample units was initially allocated evenly across the recycling collection schedule, two for each of the 10 collection days. Suburbs on a given collection day were selected randomly from each stratum. The probability of selection being equal to the proportion of suburbs in each stratum. In subsequent quarters a rotation strategy is imposed with suburbs being randomly dropped and replaced by a suburb from the same stratum.

There were two challenges in implementing the sampling plan. First, recycling from single and multiple unit dwellings in a suburb were collected on different days. In these instances, the single and multiple dwelling collections were treated as separate samples, increasing the overall sample size. Second, the sampling plan calls for the target number of households in each sample to be proportional to the number of single and multiple dwellings. This is unlikely to be achievable due to the lumpiness of multiple units and the common bins in which materials are deposited. Consequentially, the sample average of the number of glass containers per unit kilogram will tend to overrepresent and underrepresent single and multiple unit households in various suburbs.

The sample needs to be post stratified to correct for this bias. This is done by weighting the single and multiple units so that:

- The ratio of the sum of the single unit weights to the total weight equal the target proportion of single units;
- The ratio of the sum of the multiple unit weights to the total weight equal the target proportion of multiple units
- The total weight is equal to the total number of households in the sample.

Ideally, this would be done at the suburb level or strata. However, this is not practical given that in accordance with the sampling plan, multiple units were not sampled in suburbs with a small number of multiple units. So, the post stratification weights are calculated for the sample as a whole.

The raw factors from each sample were checked for outliers which, if found, are given a weight of zero. Again, the weighted factor means, standard deviations and RSEs are calculated in 'R'. The weighted standard deviations are calculated using the 'radiant.data' package.

Assuming that the sampling errors of the mean are relatively independent, the overall error margin across all material types is well within the target level of 5 per cent with a confidence bound of 95 per cent.