Review of packaging mass balance measurements

for Packaging Council of New Zealand

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Infometrics

Authorship

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Objective

The Packaging Council of New Zealand has requested a review of methods for assessing the mass balance of packaging materials in New Zealand. The Council has for a number of years produced estimates of the mass balance of packaging materials (paper, plastics, steel, aluminium, and glass). However, there has been growing concern about the reliability of these estimates in recent years.

In the current report we review the method, data sources and present initial estimates based on a new simplified approach. Our preferred approach is, with the exception of glass, rely on Statistics New Zealand export data for estimates of recovery volumes and to calculate recovery rates as a proportion of population or GDP measures rather than material specific estimates of consumption or usage. A critical aspect of the choice of method is to allow reliable and easily calculated international comparisons of packaging material recovery rates.

International comparisons suggest that resulting estimates of New Zealand recovery rates are consistent with those recorded in Australia, Europe and the US. Further it would appear that many of the issues apparent in New Zealand are global in nature.

Method issues

The key aim of mass balance exercises is usually to estimate recovery rates of material use. The usual approach is to estimate the recovery rate as the amount of material recovered by recycling activities as a percentage of usage. In practice there are a number of difficulties in obtaining accurate estimates. First there are no official collections of data on the usage or recovery of used materials in New Zealand. This means that all estimates rely on informal data collection. A result of there being no official obligations to collect data is that what data is available is fragmented and lacking in consistency. Waste collection agencies that do collect data will potentially use different units of measure and use different methods for grouping data. The net result is that estimates of usage have usually relied on indirect residual approaches, with usage calculated as production (net of changes in stock holding), less exports plus imports.

Such an indirect approach is problematic in terms of packaging material as much of the international trade is indirect in nature: the packaging material is primarily exported and imported as the packaging of other products, eg as the packaging around food exports, as the packaging around imported electronic equipment, and so on. The lack of official data collection requirement also harms potential measurement accuracy both because there is a risk that there is a lack of full coverage of all relevant organisations who produce, use, or recover packaging materials and because one is then reliant on the goodwill of third party agencies to provide accurate information. The generation of accurate data will potentially be compromised by relevant agencies not collecting data in a suitable format, by a lack of interest marring the willingness to bear costs in the collection of data, and due to commercial sensitivities about divulging firm specific information.

A final key concern relates to the focus on recovery rates. A recovery rate is usually expressed as a percentage (recovery as a percentage of usage). So if both recovery and usage are measured with error, these errors can compound to make even larger errors for the resulting recovery rate estimates. To illustrate, imagine a material that has a true recovery rate of 60%, but that there is a 10% margin of error in the measurement of both the usage and the amount of recovery. This would mean, for example that if true usage and recovery was 100 tonnes and 60 tonnes respectively, then estimates of usage could range from 90 to 110 tonnes and estimates of recovery from 54 to 66 tonnes. In which case estimates of the recovery rate could vary from 54/110 (= 49%) to 66/90 (=73%). So if one year the estimated recovery rate was estimated to be 55% and the

next year it was estimated to be 67%, could one really be sure that there had been any material improvement in the recovery rate?

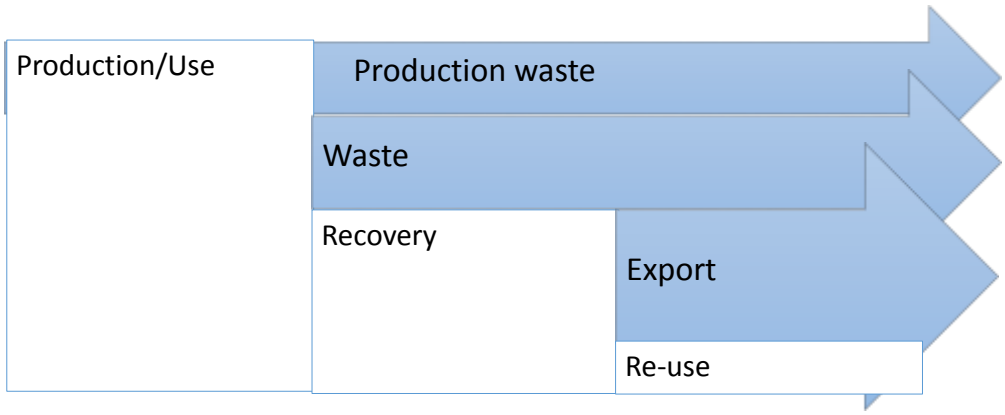
Approach

Our approach is to greatly simplify the estimation approach and use data that is likely to be measured with higher levels of accuracy. In doing so we are potentially sacrificing some of the direct relevancy of the data, but we think that this is compensated by ease of data collection, reliance on official data, and fewer sources of compounded errors.

Measuring recovery volumes

A simplified schematic of material flows is presented in Figure 1. Waste is produced both in the production process (eg off-cuts) and after use (eg used packaging). Some of this is recovered either for domestic re-use or for export. For most packaging materials, there appears to be very little opportunities for re-use within New Zealand. The exceptions are paper and glass products. For plastic, steel (ie primarily tinned steel) and aluminium recovered packaging materials, the majority of viable re-use takes place overseas. We therefore assume that all recovered plastic, steel, and aluminium packaging material is exported. Our analysis of recycling activity information collected direct from New Zealand recycling operations indicates that recycling activities are consistent with Statistics New Zealand export figures for plastic, tinned iron and aluminium can waste products.

Figure 1: Schematic illustration of material flows



For paper packaging a significant proportion of recovered material is used as feedstock into domestic packaging operations. So our approach is to calculate recovered paper packaging product as the export of non-newspaper waste paper products plus information that we have on recovered paper packaging material that is recycled within New Zealand.

For glass it is assumed that all recovered glass is recycled within New Zealand. Information on glass recovery levels are sourced from the Glass Packaging Forum website: http://www.glassforum.org.nz/statistics/.

Implications of the approaches adopted here for measuring material recoveries include:

- A risk that the measurements exclude re-use activities within New Zealand, particularly for plastic, steel and aluminium.
- Ensuring that recovery estimates do not incorporate the mere stockpiling of material that may have been collected by recovery operations.
- The incorporation of recovered and exported material by small scale operations.
- A risk of miscounting of exports that have been incorrectly coded by the export agent.

Recovery rates

To reduce the risk of compounded errors related to the high potential for mis-measurement of usage levels, we propose two alternative methods for normalising recovery levels: presenting recovery rates on a per capita basis and weighted by the level of economic activity. Presenting recovery on a per capita basis (expressed here as kg per head) allows international comparisons that have been corrected for differences in national populations. We use OECD sourced population statistics to ensure conformity of definitions across countries (see: http://stats.oecd.org/).

Using real GDP data extends the correction to account for different levels of economic activity. This correction accounts for both larger populations (countries with larger populations are naturally likely to have larger measures of GDP) and for higher wealth levels. A country with greater levels of economic activity are likely to have larger levels of consumption and usage levels of materials. Thus to have the same rate of recovery, countries with higher levels of GDP should be recovering equivalently larger volumes of used materials.

We use OECD sourced purchasing power parity (PPP) GDP measures expressed in 2005 US dollars (also available at http://stats.oecd.org/). This ensures that there is a common basis for measuring economic activity, and which corrects for differences in the spending power of currencies both between countries and across time. The recovery rates on this basis are expressed as tonnes recovered per $US1m of PPP GDP.

Results

Estimates of packaging material recovered in New Zealand in 2013 are presented in Table 1. During 2013 we estimated that545,400 tonnes of packaging material was recovered in New Zealand. Of this the majority of recovery was associated with paper materials (324,900 tonnes) and glass (165,200). These higher volumes for paper and glass reflect a combination of their higher use, greater product weight, and potentially more intense recycling activity.

Table 1: Recovery of packaging material in New Zealand, 2013

Packaging Material	Tonnes recovered	Kg per head	Tonnes per PPP GDP (2005 $USm)
Paper	324,900	72.7	2.695
Plastic	41,900	9.4	0.347
Steel	10,100	2.3	0.084
Aluminium	3,400	0.8	0.028
Glass	165,200	36.9	1.370
Total	545,400	122.0	4.524

Translating onto a per capita basis, we estimate that 122 kg of packaging material was recovered for every individual in New Zealand in 2013. On their own the recovery rates expressed in terms of tonnes per PPP GDP are not very meaningful, but take on more meaning when comparing recovery activities with other countries and across time.

International comparisons

This section includes 12 graphs presenting developments of packaging recovery rates in New Zealand, Australia, Europe, and the US over the last decade. The Australian data is based on information available from the Australian Packaging Covenant, European data is based on data from Eurostat, and the US data is based on US Municipal Waste Data.[1] New Zealand packaging recovery rates have increased over the past decade from around 100kg per person in 2003 to 122kg in 2013 (see Figure 2). Likewise the recovery rate has increased from around 4 tonnes per $1USm of GDP in 2003 to over 4.5 tonnes in 2013. Despite this upward trend there is less evidence of improvements in recovery rates in recent years, with 2013 appearing to be lower than 2012.

In terms of international comparisons, we focus here on Australia, the US, the core 15 members of the European Union, and Italy and France. Italy and France are singled out as the coverage of recovery data in these countries is more comprehensive, particularly for aluminium and steel, for which very few European countries have data. For Australia, data on glass, steel and aluminium only appears to be available since 2010. For plastics we replace Italy with Denmark, to provide an illustration from a country that is more actively engaged in waste to energy activities.

From a per capita basis, packaging recovery rates in New Zealand appear to be above those found in the US but below those in Europe. However, there has been an element of New Zealand rates catching up with European rates over the last decade. The international comparison improves further when one accounts for differences in levels of economic activity. Figure 3 demonstrates that packaging recovery rates corrected for real GDP are stronger than the comparison countries.

The results vary across the different individual packaging materials, but there is a consistency with these general results:

- New Zealand recovery performance has improved relative to other countries over the last decade.
- The New Zealand performance appears stronger using the per GDP measures.

[1] See http://www.packagingcovenant.org.au/pages/apc-recycling-data.html, http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=env_waspac&lang=en, and http://www.epa.gov/solidwaste/nonhaz/municipal/msw99.htm for Australian, European, and US data sources, respectively.

- There has been some slowing in the pace of improvement, and even some relative deterioration in recent years.

Figure 2

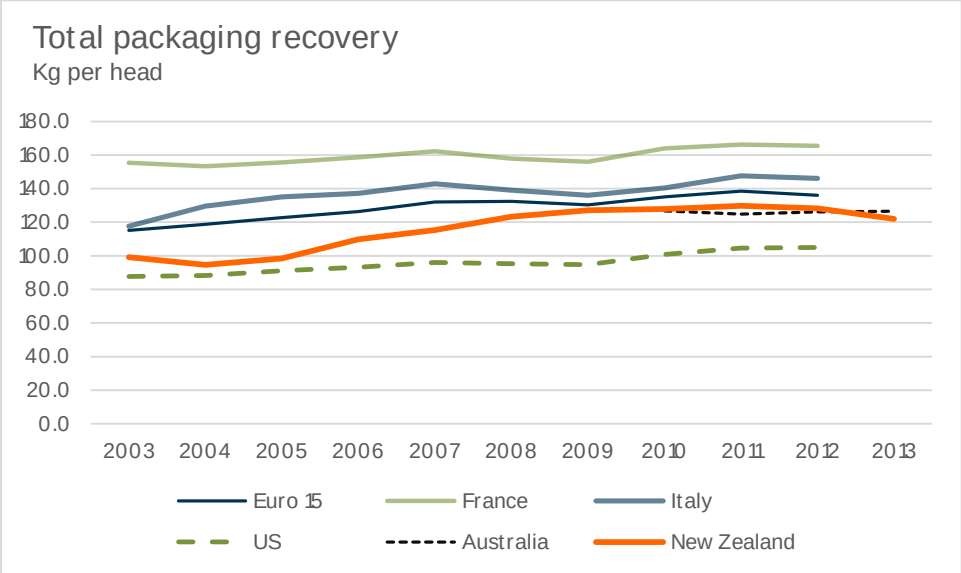
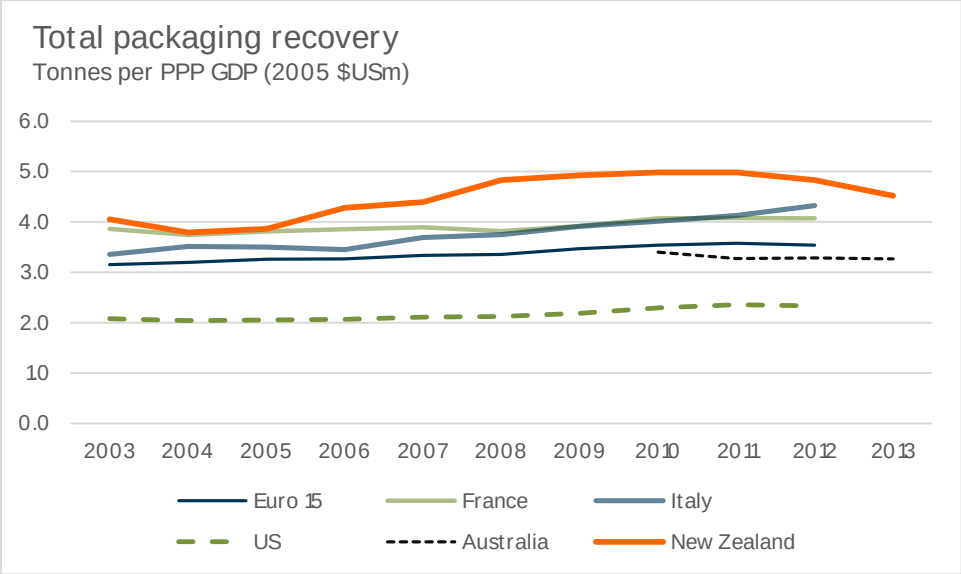


Figure 3



Paper packaging

Figure 4

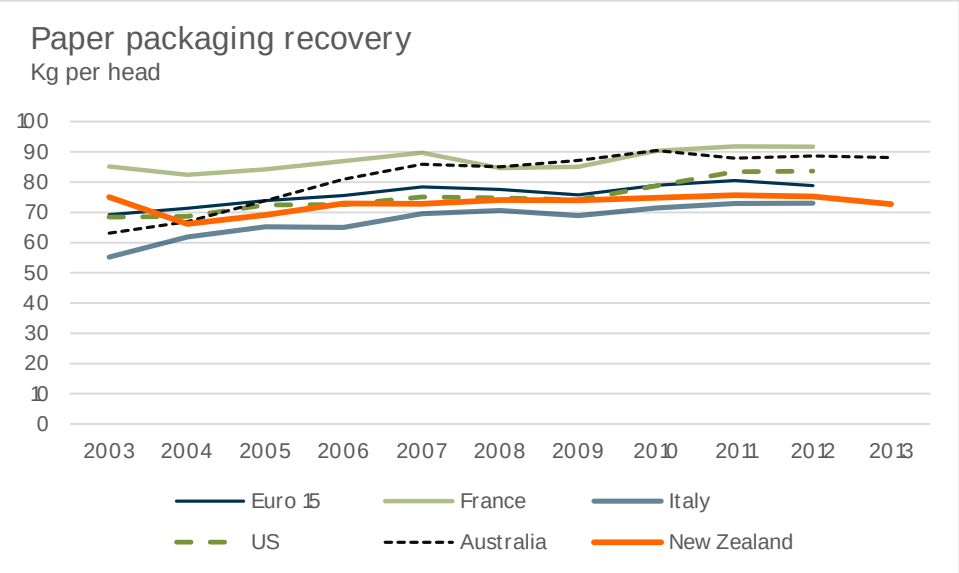
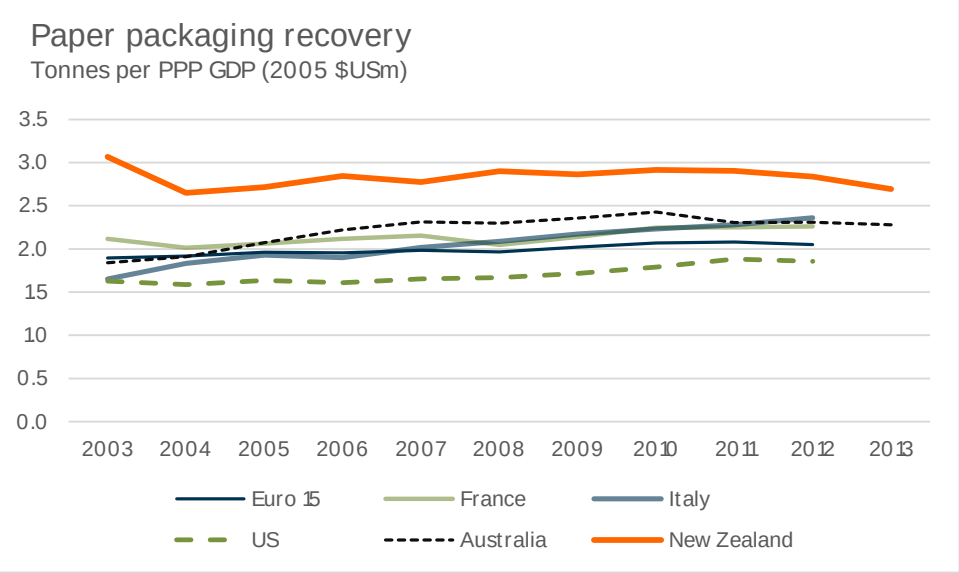


Figure 5



Plastic packaging

Figure 6

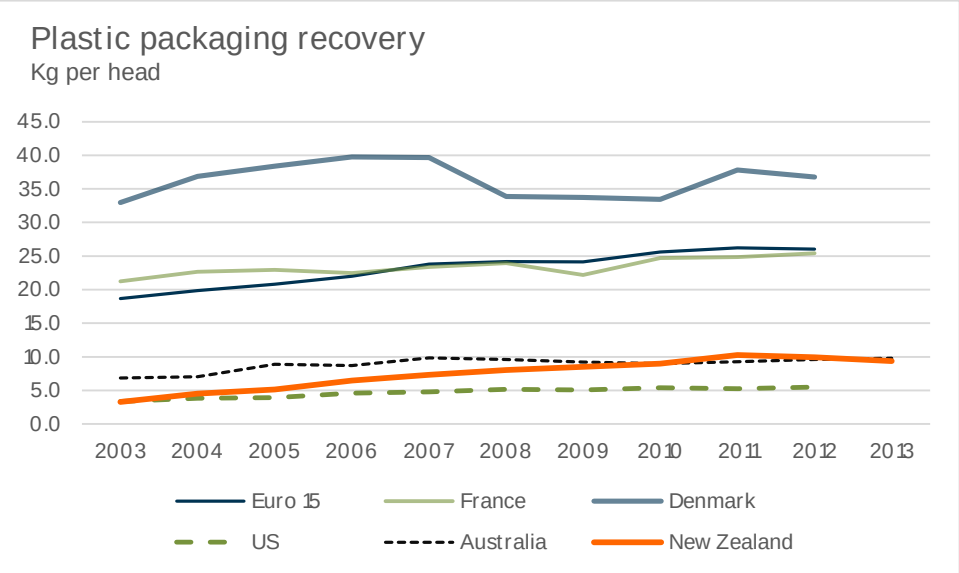
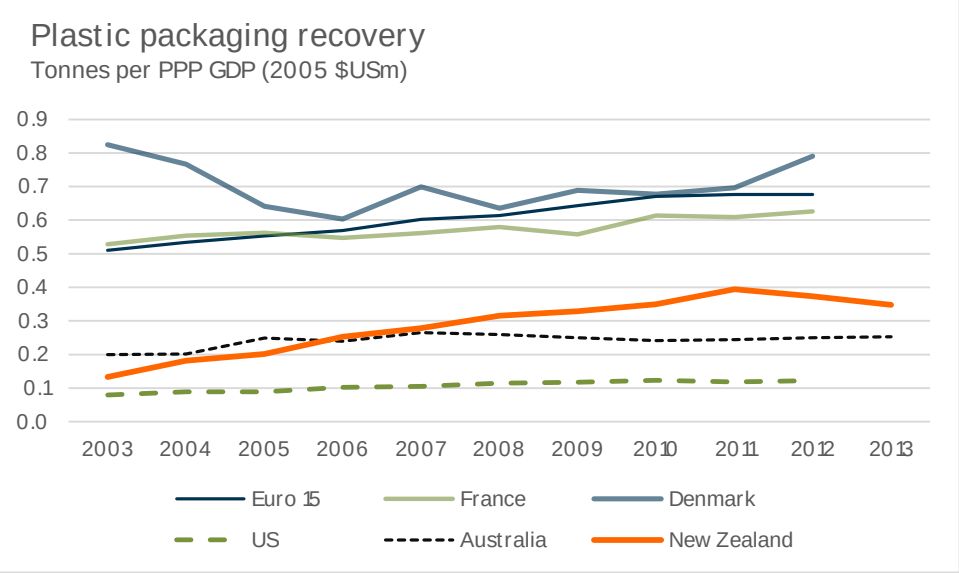


Figure 7



Steel packaging

Figure 8

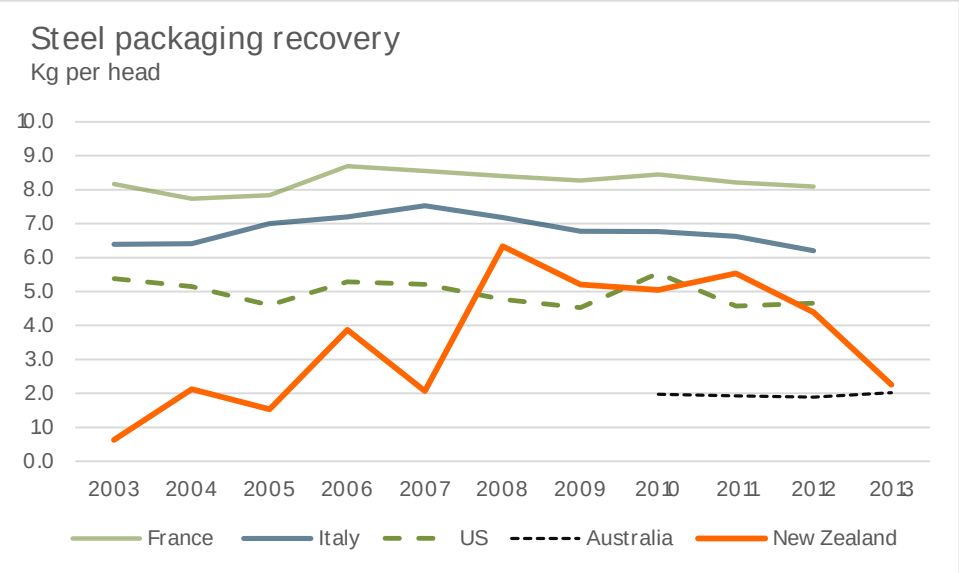
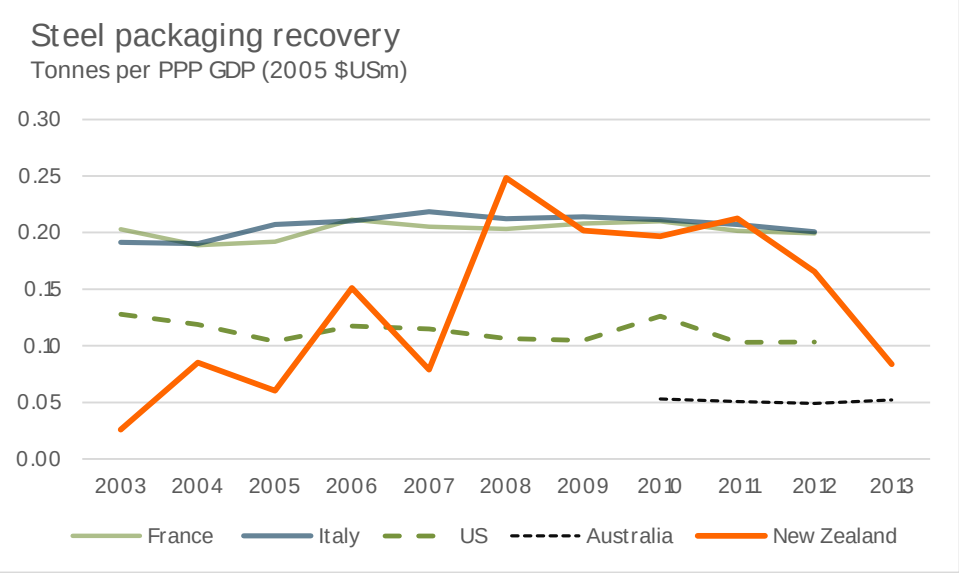


Figure 9



Aluminium packaging

Figure 10

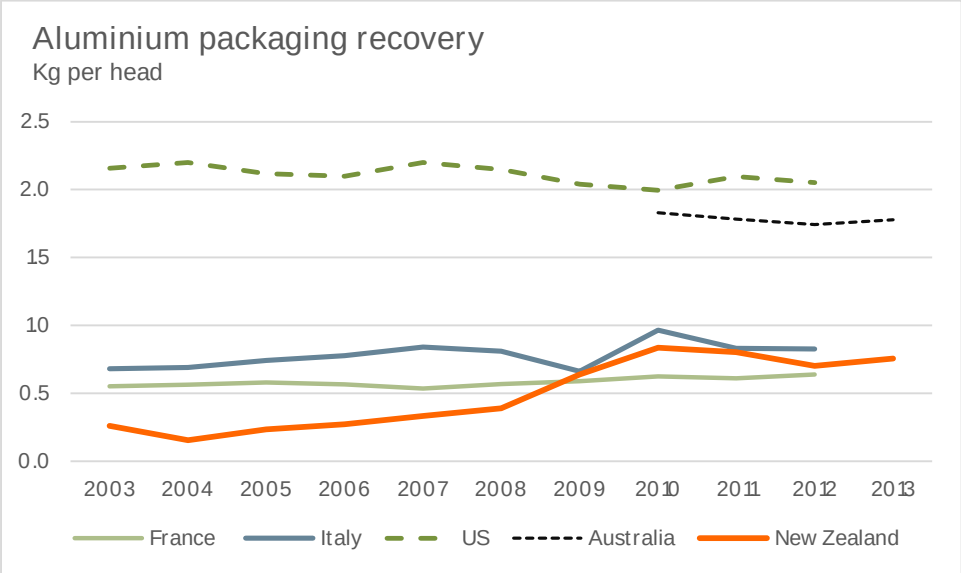
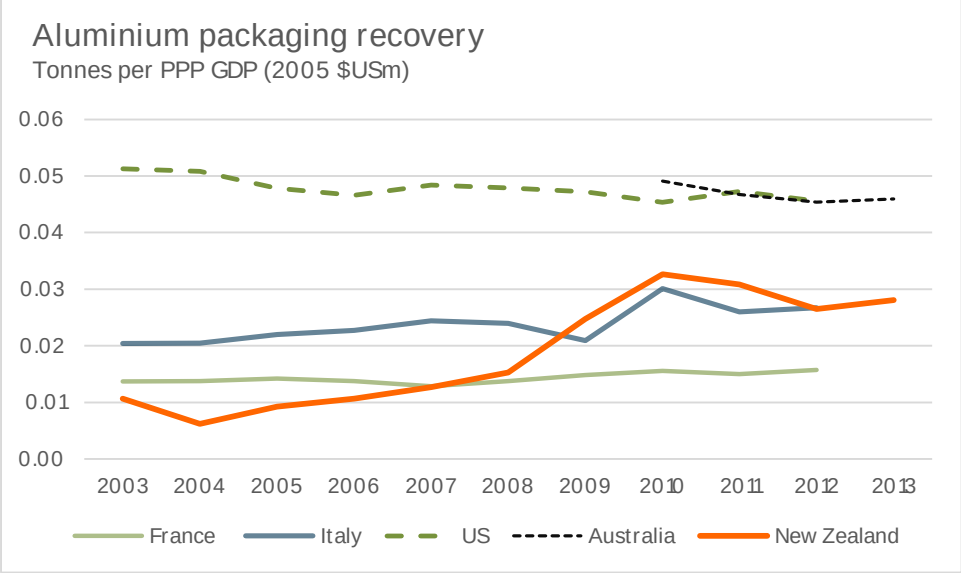


Figure 11



Glass packaging

Figure 12

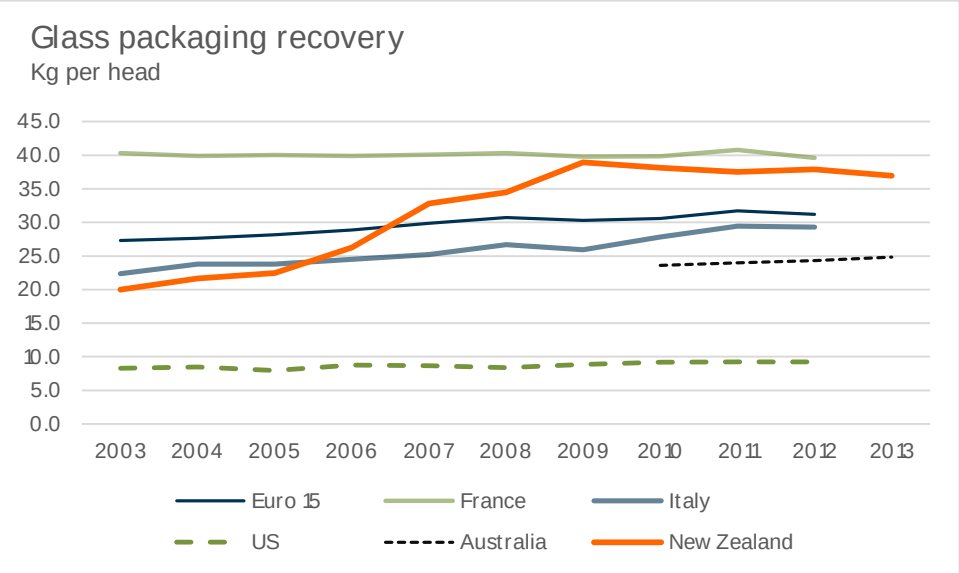


Figure 13