ICL Industrial PRODUCTS

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SKM

Introduction

There are a number of material options available to manufacturers of electronic housing components, including plastics containing fire retardant chemicals, or metals with their inherent fire retardant properties. As a producer of fire retardant chemicals, **ICL-IP** assessed the carbon emissions of a number of plastic TV Housing options that use their products. This assessment would put these specialist chemicals into the context of their life-cycle greenhouse gas emissions and compared them to emissions from other electronic equipment housing options. The study was carried out on behalf of **ICL-IP** by **Sinclair Knight Merz (SKM)** a global strategic consultancy.

What is Product Carbon Footprinting?

A product carbon footprint measures the Greenhouse Gas (GHG) emissions at each stage of the products life. This includes:

- Extraction, production and transportation of raw materials
- Manufacture of service provision
- Distribution
- End-use
- Disposal/Recycling

At each stage GHG emissions can result from such sources as: energy use, transport fuel, refrigerant losses from AC units and waste.

Carbon Trust (2011)

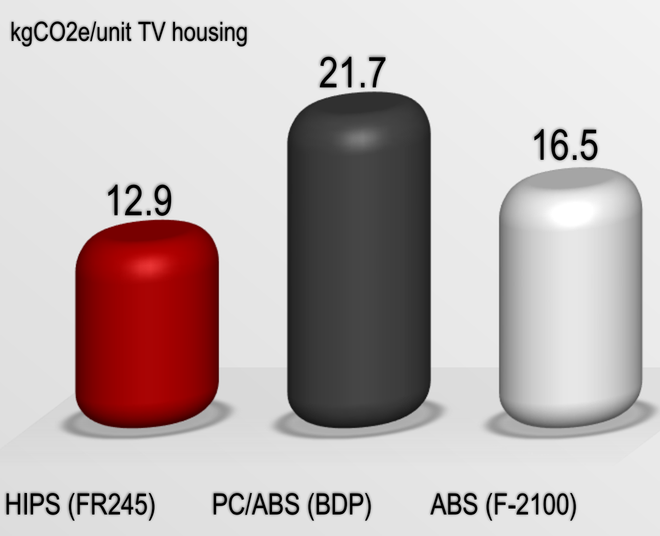
The Study: Methodology, Boundaries, Assumptions

► The **methodology** used for the carbon footprints was based on the principles of carbon footprinting as outlined in PAS2050 which provides a method for assessing the GHG emissions arising throughout the lifecycle of products.

► The **scope and assumptions** of the footprints include upstream, on-site manufacturing, product delivery, injection moulding (or embossing for the metallic options) and moulded/embossed product delivery carbon emissions. Upstream emissions cover raw material extraction, supplier manufacturing and supplier delivery. On-site manufacturing emissions cover energy use, water use and waste treatment. Delivery includes the emissions that occur from packaging and transporting the final product to the TV assembly point gate.

► All product footprint calculations outlined in this report followed the **cradle-to-gate boundary** to the point of assembly of the final TV product. It is expected that any differences in life cycle emissions for the "in use" and "end of life" stages for the selected products will be insignificant, and so these stages are not assessed. As a caveat to the metallic products, the footprint emissions will be greatly determined according to the levels of recycling and these are accounted for at the beginning of the product's life-cycle.

Study Results: HIPS (FR245), PC/ABS (BDP), ABS (F-2100)

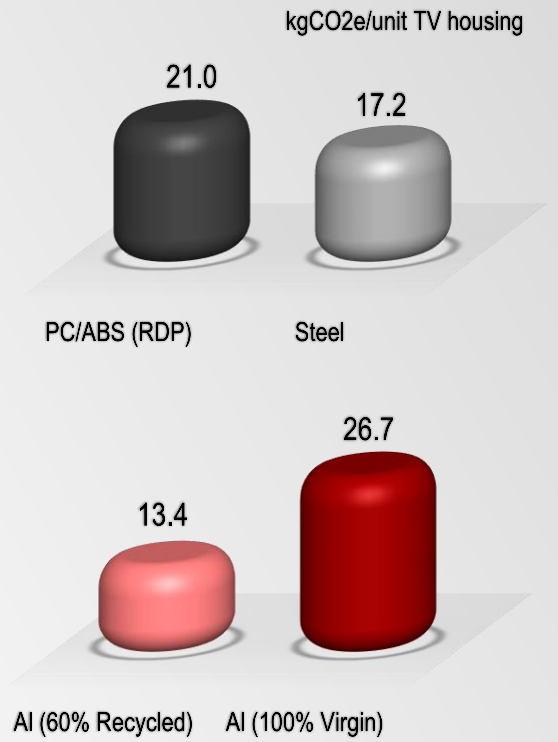


► **HIPS (FR245):** HIPS (FR245) consists of a blend of inputs including High Impact Polystyrene (HIPS, 81% of inputs) a widely used plastic, the fire retardant FR245 (15%) which is supplied from **ICL-IP's** Ramat Hovav site in Israel, and antimony trioxide (4%) which is used for its properties as a flame retardant synergist. These inputs are blended to produce granules and moulded into the required form using an injection moulder.

► **PC/ABS (BDP):** PC/ABS (BDP) is a blend of two plastics – Polycarbonate (PC, 70%) and acrylonitrile butadiene styrene (ABS, 17%) blended with the additive polytetrafluoroethylene (PTFE, 0.5%) and bisphenol-A bis(diphenyl phosphate) or BDP (12%) supplied from **ICL-IP's** Gallipolis Ferry site in the USA. These inputs are blended to produce granules and moulded into the required form using an injection moulder.

► **ABS (F-2100):** this is a blend of ABS (74%) and the fire retardant (F-2100) (20%) supplied from **ICL-IP's** Ramat Hovav site and Antimony Trioxide (6%) from a European supplier. These inputs are blended to produce granules and processed via an injection moulder.

Study Results: Other TV Housing options



▶ **Aluminium:** Due to the nature of aluminium production, each kg of product is relatively carbon intensive and a kg of virgin (or "primary") aluminium can have a carbon intensity exceeding 12 $kgCO_{2e}/kg$ (~4 times higher than many plastics). However, the recycling process is very efficient, and recycled (or "secondary") aluminium can have a carbon intensity of less than 1.5 $kgCO_{2e}/kg$. This option was assessed twice in order to take into account the impact of using recycled aluminium within the product's life-cycle and in order to illustrate the sensitivity of recycled aluminium within the product's supply chain. 60% recycled is based on a manufacturers specification, so is assumed to be a valid recycled content.

▶ **Steel:** Steel is an alloy of iron and carbon, and its production per kg of output is less carbon intensive (i.e. less than half the emissions compared with many plastics). However, Steel is a comparatively weak metal when compared with other options, thus the assessment assumed that the weight of steel per unit was nearly twice that of the plastic options.

▶ **PC/ABS (RDP):** PC/ABS (RDP) is a blend of two plastics – PC (73%) and ABS (18%) which are blended with the additive PTFE (0.5%) and resorcinol bis (diphenyl phosphate) or RDP (9%) supplied from **ICL-IP's** Bitterfeld site in Germany. These inputs are blended to produce granules and moulded into the required form using an injection moulder.

▶ **HIPS (FR245):** had the lowest emissions per unit of the plastic options in the assessment. HIPS has an intrinsically low emissions factor and the process to mix the HIPS granules is a fairly carbon un-intensive process. HIPS can also be moulded at lower temperatures than PC, requiring less energy. The additives are added in low quantities, and are relatively carbon un-intensive.

▶ **PC/ABS (BDP):** this option is less favourable than the HIPS (FR245), with a ~40% difference between the two. This difference in the results can be explained due to the fact that the emission factor for the main input for PC is double that of HIPS.

▶ **ABS (F-2100):** the emission intensity per kilo for this product sits between that of the PC/ABS and HIPS products. The main influencing factor for this is that the main raw material inputs for ABS is less than PC but more than HIPS.

Explanation of Results

▶ **Aluminium & Steel:** Aluminium (60% recycled) and steel sit within the result range of the PC/ABS and HIPS products. When 100% virgin aluminium is used the emissions per product nearly double compared to 60% recycled content product.

▶ **PC/ABS:** the subtle differences between the two different PC/ABS products, are due to the BDP product containing less plastic and more additives than the RDP product.

▶ **Aluminium Vs. HIPS:** due to significant uncertainty associated with all the product footprint data used in the study, and particularly with the Aluminium product specifications it cannot be conclusively stated that HIPS is the 'best' option. However, the results do not suggest that Aluminium will be significantly lower than HIPS, and results in the study suggest this may even be similar or higher emissions per product.

Summary

The results of this study are subject to significant uncertainty due to the assumptions made in the hypothetical product specifications and in the input data. Bearing this uncertainty in mind, the footprint analysis suggests that:

▶ Among plastics solutions, HIPS flame retarded by FR-245 is the best option of those assessed with significantly lower emissions than PC/ABS flame retard by BDP. Results indicate that the carbon intensity of ABS flame retarded by F-2100 is less than the PC/ABS products, but more than the HIPS product.

▶ Metallic options did not appear to emit as much GHG emissions per unit as expected given their relative weight and carbon intensity. Steel was slightly above the ABS product but better than the PC/ABS, and aluminium (if 60% recycled is selected) was similar to or slightly worse than HIPS subject to uncertainty.