# LIFE CYCLE ASSESSMENT

## Life Cycle Assessment of Expanded Polystyrene Packaging
## Case Study: Packaging system for TV sets

### Goal and Scope of the Study

The European Manufacturers of Expanded Polystyrene Packaging (EUMEPS Packaging) commissioned independent, international Consultants PricewaterhouseCoopers/Ecobilan to conduct a Life Cycle Assessment (LCA) on Expanded Polystyrene (EPS) used in TV-packaging. TV Packaging was chosen as a well known popular application. The two objectives were to identify the sources of environmental impacts associated with the use of EPS packaging and to quantify the improvements by recycling.

Throughout 2001, 15 industrial EPS manufacturers located in 10 European countries as well as major European TV manufacturers participated in the study that concentrated on the packaging of a 25″ TV set. A typical system was considered, comprising: EPS packaging (0.7 kg), a cardboard box (2.8 kg) and PE foam (0.1 kg) giving a total weight of 3.6 kg for an average weight of TV of 27.6 kg.

### Methodology

This LCA study corresponds to a "cradle-to-grave" investigation, i. e. the whole life cycle of the EPS packaging system for a 25″ TV set has been considered. The study follows the international standards (ISO 14040-14043) and an external critical review has been carried out by Dr. Postlethwaite, an independent LCA expert, who commented: "Overall, a well-executed professional LCA fulfilling the objectives of the work and presented in a lucid and exemplary manner".

The whole system from production of virgin raw material (expandable polystyrene) to the management of used packaging has been broken down into 8 subsystems (see figure 1) which have been checked individually and in-depth. 30 main environmental indicators were analysed in 11 different scenarios (sensitivity analyses).

**Figure 1: Life cycle steps**



# European Manufacturers of EPS Packaging
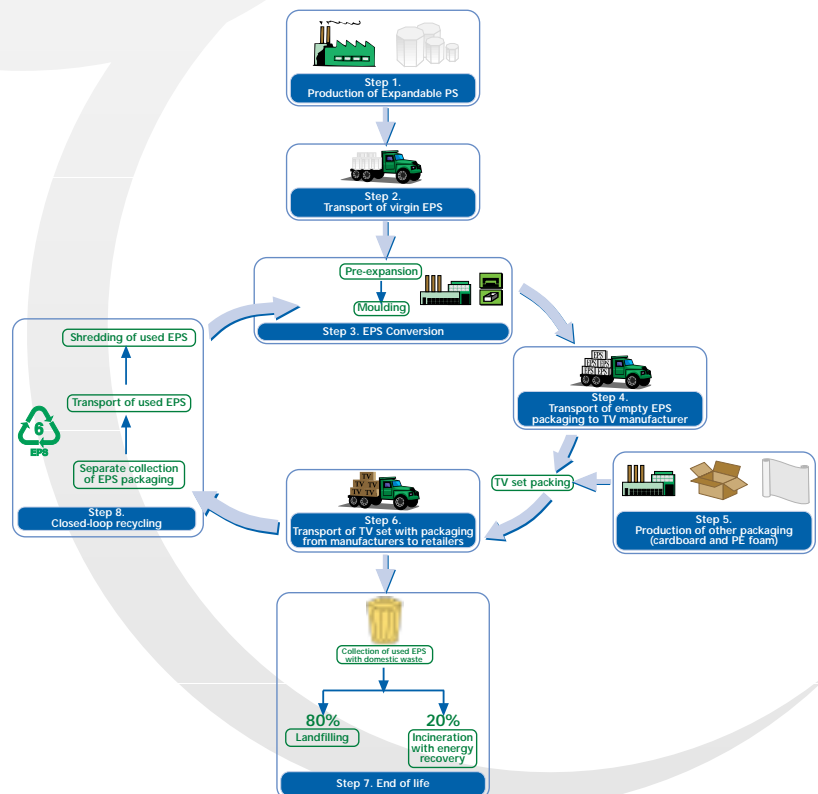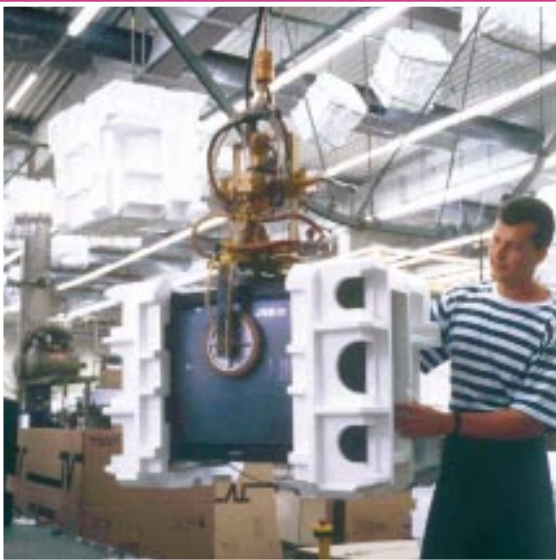
## Results

The LCA results consist of data relating to the reference scenario and of a set of sensitivity analyses simulating variations in key parameters such as the weight of EPS packaging, the fate of domestic waste (breakdown between landfilling and incineration), and the rate of closed loop recycling.

### Reference scenario (without recycling)

•For the EPS packaging itself the main stages in terms of environmental impacts are limited to the virgin expandable polystyrene production stages and the conversion stage (resource consumption and air emission). For resource consumption, the primary energy is mainly consumed at virgin EPS production while water is essentially used at the conversion stage.

•Most of the releases to air are dominated by the manufacture of EPS from virgin sources while for photochemical oxidant formation specifically, the conversion stage dominates the results.

•The LCA results clearly demonstrate that the ozone layer depletion is not an issue for EPS.

•The impacts surrounding the transport of EPS packaging are minimal (transport distances are typically small due to lightweight of EPS). It can also be noted that the study only measures the impact of the packaging and additionally considering the transport of TV sets would result in 20% more primary energy consumption, 74% greater air acidification as well as 38% more of the greenhouse effect.

•In respect to the total TV-packaging system (including cardboard and PE foam) a significant contribution to the environmental impacts has been found for the cardboard component. This material, despite its recycled fibre composition, is responsible for 94 % of the total water eutrophication*, for 74 % of the waste production, for 51 % of the water consumption and for 47 % of the primary energy consumption (see figure 2).When the 35% EPS recycling rate is considered, the relative impact of cardboard becomes even more significant (figure 3).

### Sensitivity Analyses (considering alternative scenarios for the EPS packaging component only)

When compared to the reference scenario, in addition to classical process improvements (energy and resource consumptions), the study demonstrates ways in which the environmental impact can be reduced through source reduction, recycling and recovery:

•In terms of source reduction, a 20% decrease of EPS weight by improved design reduces the environmental impacts by 10 - 20%.

•In terms of recycling, a 35 % rate of EPS recycling decreases the environmental impacts of the total packaging system by 10 - 20 % for most of the criteria and by 30 % for photochemical oxidants formation.

•In terms of waste management, the complete replacement of landfilling by energy recovery (even with no recycling) would allow an improvement in the environmental performance, in most categories, of 15-30%.

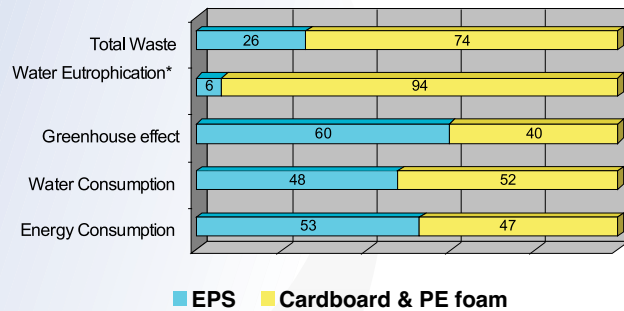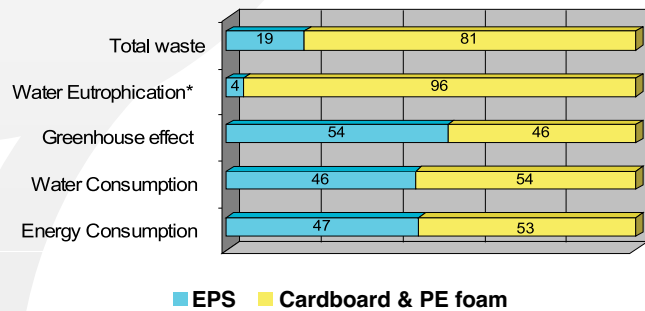**Figure 2: A selection of environmental indicators (reference scenario)**



| | EPS | Cardboard & PE foam |
|---|---|---|
| Total Waste | 26 | 74 |
| Water Eutrophication* | 6 | 94 |
| Greenhouse effect | 60 | 40 |
| Water Consumption | 48 | 52 |
| Energy Consumption | 53 | 47 |

■ **EPS** ■ **Cardboard & PE foam**

**Figure 3: A selection of environmental indicators ( 35% EPS recycling)**



| | EPS | Cardboard & PE foam |
|---|---|---|
| Total waste | 19 | 81 |
| Water Eutrophication* | 4 | 96 |
| Greenhouse effect | 54 | 46 |
| Water Consumption | 46 | 54 |
| Energy Consumption | 47 | 53 |

■ **EPS** ■ **Cardboard & PE foam**

*Eutrophication measures the water pollution due to nutrients (mainly nitrogen and phosphorus)

## Conclusions

This LCA study fulfilled its two initial goals allowing the European EPS packaging industry to confirm the parameters where an improvement of the current situation (25% recycling already achieved) would have the best environmental effects. The European EPS industry is pleased to share the conclusions of this scientific study that quantifies the environmental impact of EPS.

With this environmental conclusion in mind, it is important to note that EPS remains the best protective packaging solution for valuable goods.

Note:   More detailed information about the LCA study is available from the International EPS website www.epsrecycling.org

EUMEPS Packaging
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