STEEL FOR PACKAGING

LIFE CYCLE ASSESSMENT ON TINPLATE

March 2012

About Life cycle Assessment (LCA)

LCA’s create a complete environmental profile of products over their entire life cycle, and show the results with the aid of environmental indicators in a more understandable way.

What makes a product more eco-friendly? What makes its production more sustainable? Many aspects contribute to the sustainability of a product, one of which is the packaging. The steel for packaging industry has always been concerned with the continuous improvement of the environmental impact of packaging – with increasing success:

The mandatory recycling rate in the EU for tinplate has been more than achieved for years. No other packaging material achieves higher recycling rates than tinplate. But recycling is only one indicator of good environmental performance. Other aspects also have to be (and are) taken into account by the Steel for packaging industry.

Awareness of Environmental Impact

In order to make packaging more environmentally friendly and to keep improving, it is necessary to know the environmental impact entirely and precisely. It is important to consider the whole life cycle to be able to establish a comprehensive environmental profile.

APEAL - the Association of European Producers of Steel for Packaging - has carried out a comprehensive life cycle assessment (LCA) for tinplate production in Europe in 2011 to create such an environmental profile. With life cycle assessment the whole lifespan of a product can be evaluated: the production, use and disposal at the end of life. In comparison with previous assessments the results show that the Steel for packaging industry has made significant improvements in its environmental performance; CO_2 emissions[1] in tinplate production were reduced by 9% over the study period.

[1] The effect on global warming is measured in CO_2 equivalents. In this publication “CO_2 emissions” is written instead of CO_2 equivalents due to better readability.

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Tinplate and Sustainability

Producing eco-friendly packaging, while using highly energy and resource efficient technologies has always been a common target of the steel packaging industry. Today beverage cans made of tinplate are over 35% lighter than 20 years ago. The recycling rate has increased year after year and more and more metal scrap has been recycled back into the material loop.

Above and beyond EU legislation requirements

The European mandatory recycling rate[2] of 50% for metals, in law since 2009, had been achieved by tinplate eight years earlier. Overall, tinplate is the most widely recycled packaging material in Europe compared to plastics, laminated cartons and glass. In Europe the recycling rate of steel packaging has increased nearly threefold in the last 20 years from 25% in 1990 up to 72% in 2009[3].

Thanks to its unique magnetic properties, steel can be sorted and recovered very easily. Unlike other materials, steel is infinitely recyclable without losing its properties and qualities. Highly efficient collection and recovery routes have therefore been established in recent decades. Certain steel products are currently made of up to 100 % steel scrap. Using scrap instead of primary raw materials to produce tinplate can reduce the CO_2 emission by almost two thirds.

Life-Cycle Thinking: Looking beyond the factory gate

Environmental impacts occur along the entire supply chain: at the production site itself as well as in the extraction of raw materials and their transport, and at power plants supplying the energy to the production site. In order to capture all environmental impacts of a product, it is therefore necessary to look beyond the factory gate. With life cycle assessment the whole lifespan of a product can be evaluated: the production, use and disposal at the end of life.

Disclosing the « real » product footprint

Thinking in life-cycles has an important advantage: Capturing both direct and indirect impacts can help to avoid shifting environmental burden from one life cycle stage to another. Thus, the “real” environmental footprint can be disclosed. Meanwhile LCA is well established as a sound environmental assessment tool.

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[2] According to EU directive 2004/12/EC
[3] This LCA study was carried out using the 2009 recycling rate

More and more experts in industry and science use LCA datasets to assess products, entire supply chains or new product developments in the design phase. To offer current LCA datasets based on averaged real industry data APEAL has commissioned a comprehensive LCA study on European Tinplate production.

Results – continuous trend towards more eco-friendly products

The results of the study clearly show that the European Steel -for packaging industry has continued its trend towards a more energy-and resource-efficient production. The environmental impact of tinplate production is displayed for the five standard impact categories; global warming (GWP), acidification (AP), eutrophication (EP), photochemical ozone creation (POCP) and primary energy demand (PED).

Within two years, the CO_2 emissions (GWP) of tinplate production have decreased by 9%. The values for acidification (-6%) and eutrophication (-11%) have also reduced. Compared to 2006 the primary energy demand decreased slightly by 3%. The increase in POCP (+6%) is due to methodological changes.

Figure 1: Primary Energy Demand (without and with Recycling Credit

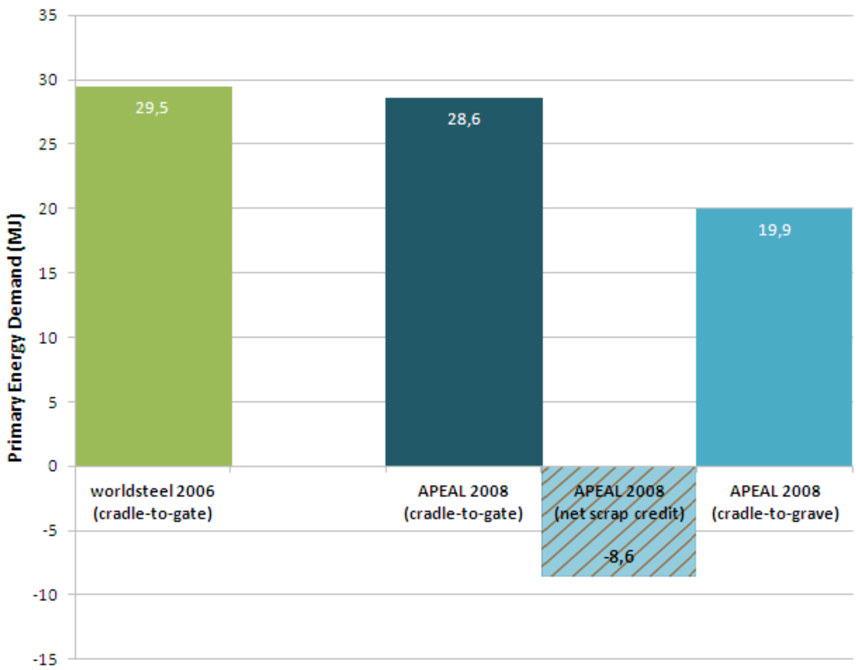

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Figure 2: Global Warming Potential (without and with Recycling Potential)

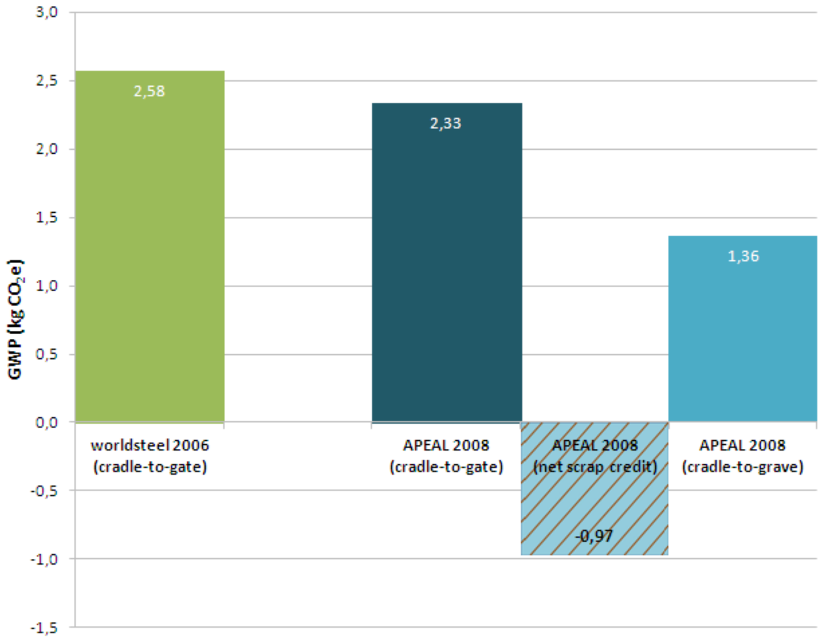

Figure 3: LCA results for 1 kg Tinplate coil (without End of Life)

Category	**value**	**Unit**
Global Warming Potential (GWP)	2.33	Kg CO_2 eq.
Acidification Potential (AP)	5.8E-03	Kg SO_2 eq.
Eutrophication Potential (EP)	4.0E-04	Kg Phosphate eq.
Photochemical Ozone Creation Potential (POCP)	1.0E-03	Kg Ethene eq.
Primary Energy Demand (PED)	28.56	MJ

Recycling significantly reduces impact

In absolute values, the global warming potential of 1 kg of tinplate coil produced in Europe amounts to 2.33 kg of CO_2. This corresponds roughly to the amount of CO_2 emitted by a family car driven a distance 16 km. 46 food cans (425 ml) can be produced with 1 kg tinplate coil. The primary energy demand of 1 kg of tinplate is 28.6 MJ, equivalent to the energy consumed by an economical washing machine over 3 wash loads.

However, considering the fact that in Europe around 72% of tinplate is recycled, the results change significantly. The primary energy demand is reduced from 28.6 MJ to 19.9 MJ when 72% of recycled material is used, meaning that a 30% energy saving is possible by using scrap instead of primary resources. The CO_2 emissions also reduce by 42% from 2.33 kg to 1.36 kg.

If a theoretical recycling rate of 100% is used, the CO_2 emissions decrease by more than 60%. In fact this calculation is more than just theory. In Germany, 93% of tinplate is currently recycled, and at 98% almost all tinplate produced in Belgium is recovered.

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About the study

The study evaluates the European production of tinplate coil in a so called cradle to gate analysis, meaning that all production steps from the extraction of raw materials to manufacturing of the coil were taken into account. In addition, the potential effect of recycling was calculated assuming the European average recycling rate.

High coverage: 95% of European Production included

The four major tinplate manufacturers, ArcelorMittal, Tata Steel, ThyssenKrupp Rasselstein and U. S. Steel Kosice, all participated in the study, delivering data from eight operating sites. This results in a high coverage and therefore high data quality and representativeness of the study: 95% of European tinplate production was covered by the study. The data were based on 2008 production values, and were collected in a very detailed way on a site-by-site and process-by-process basis. In order to ensure a high data quality, the study was also checked by independent external experts in a so-called critical review.

The study updated existing LCA data from 2006 produced by the Worldsteel Association as part of an LCA study of steel products. The study was conducted according to the international standards for life cycle assessment ISO 14040/44 and the Worldsteel LCA methodology, in order to be able to compare the results with existing LCA tinplate data and to be able to apply them in other LCA studies. APEAL has made the LCA dataset publicly available, so it can be further used as the reference set for steel for packaging production in Europe in science and industry.

Further information about LCA

The procedure to conduct an LCA is defined in the international standard ISO 14040/44. Although LCAs calculated in accordance to ISO are based on the same procedures, results are not comparable in any case. An important step in an LCA is to define the product as a so called functional unit and define the system boundaries of the study. Depending on the product's definition and which process steps are included or excluded (boundaries) the results of similar products can vary significantly. As an example: Considering the end of life of steel products would lead to a smaller environmental impact as resources are saved through recycling.

An LCA calculates the environmental impact capturing all energy and material flows in all considered life cycle steps. The emissions to the environment that occur in each process step- are different and numerous. The emissions are therefore grouped in major categories and characterised accordingly to their effectiveness, in order to show the impact in only a few figures and allowing for easy interpretation of the results. As an example, both carbon dioxide (CO_2) and methane contribute to global warming but methane is 25 times higher than CO_2. Common impact categories include global warming, acidification and eutrophication of the environment and the production of summer smog

Impact categories and what they mean

Global Warming Potential (GWP 100 years): GWP is mainly caused by CO_2 and CH_4 emissions, which account for around 98% of GHG emissions from the steel industry. Expressed in units of kg carbon dioxide equivalents (kg CO_2e).

Acidification Potential (AP): A measure of the acidifying potential of substances; primarily caused by SO_2 and NOx. Expressed in units of kg sulphur dioxide equivalents (kg SO_2e).

Eutrophication Potential (EP): A measure of the potential for the enrichment of nutrients in lakes and rivers, leading to abnormally rapid algae growth in water courses and damage to soils. Within the steel industry, EP is mainly caused by NOx emissions. Expressed in units of kg phosphate equivalents (kg PO_4e).

Photochemical Oxidant Creation Potential (POCP): A measure of the potential for the creation of low-level ozone and other air pollutants. Also known as 'summer smog'. Expressed in units of kg ethene equivalents (kg C_2H_4e). POCP is mainly caused by CO emissions.

Glossary

Cradle to gate

At the beginning of an LCA study the system boundaries are defined, i.e. which process steps or life cycle phases will be considered and which not. A scope from cradle to gate covers all of the production steps from raw materials “in the earth” (i.e. the cradle) to finished products from the factories (i.e. the gate). A cradle to grave approach goes further and also includes the use phase and the end of life of a product.

Critical review

LCA studies can be reviewed by an external expert to guarantee a high degree of quality. According to the ISO standard in some cases such a critical review is mandatory e.g. if the study comprises a comparative assertion disclosed to the public.

Impact Categories

In LCA impact categories are used to present the results in a few key figures, in order to give a better overview of the effect on the environment. All inventoried resources and emissions are associated with one or more impact category, such as global warming potential or acidification potential, according to their contribution to this category. For example, both carbon dioxide and methane contribute to global warming. Methane, however, is 25 times stronger. The units in impact categories are equivalents to a defined reference substance (e.g. global warming is measured in carbon dioxide equivalents). How substances affect the environment and how intensively they do this is analyzed and defined by scientific methods.

ISO standard

LCA has been standardized by the International Organization for Standardization (ISO). The international standard ISO 14040/44 defines how to conduct an LCA study and how to report the results.

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