

Recycling for climate protection.

Results of the Fraunhofer UMSICHT study on CO₂ savings through recycling –
an analysis for the ALBA Group.



ALBA Group-Recycling saves more
than 6.2 million tons of CO₂ p.a.*

*Source: Fraunhofer UMSICHT





ALBA Group

The ALBA Group consists of the two pillars ALBA and Interseroh and is one of the world's leading recycling and environmental services providers as well as suppliers of raw materials: in Europe it takes fifth place and is one of the top ten in the world. Interseroh's activities concentrate on organising the take-back of packaging and products as well as marketing of secondary raw materials, in particular scrap metals. ALBA's operative work focuses on disposal services in the municipal and commercial sector, marketing secondary raw materials, the development and operation of recycling and production plants as well as planning and performing facility services.

Fraunhofer UMSICHT

The Fraunhofer Institute for Environmental, Safety and Energy Technology UMSICHT is one of 59 institutes of the Fraunhofer-Gesellschaft in Germany. Fraunhofer UMSICHT researches and develops applied and custom-made process engineering technologies. It assumes a leading position in the fields of environmental and material technologies, process engineering and energy technology with technical innovations. A key goal is to improve the standard of living of people on a sustainable and ecological basis and to promote the innovation capacity of the national economy.



Dear Readers,

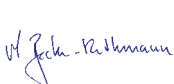
The social challenges related to raw materials and the environment are growing on a daily basis. Growth in threshold countries is leading to an increase in consumption and thus the amounts of waste produced and the demand for raw materials.

As a country poor in raw materials, Germany is facing the problem of developing new sources of raw materials that are both climate-friendly and sustainable. Waste is our most important source of raw materials. The recycling sector of the German manufacturing industry already supplies raw materials worth over 12 billion euros that would otherwise have to be imported at great expense.


We were able to impressively demonstrate that the production of secondary raw materials from waste also makes an important contribution to climate protection for all relevant material flows for the ALBA Group for the first time in spring 2011, relative to 2009, together with the well-known Fraunhofer Institute UMSICHT. We are delighted to be able to present the update of this study for the reference year 2010. It once again shows just how much the waste management sector can contribute to savings in harmful CO₂ emissions: the ALBA Group saved a total of **more than 6.2 million tons of CO₂ in 2010**. The following pages contain more detailed results. We wish you an exciting and informative read.


Yours sincerely

The Board of ALBA Group plc & Co. KG


Martin Becker-Rethmann



Dr. Markus Guthoff


Dr. Axel Schweitzer


Dr. Eric Schweitzer


Hermann Holstein


Eric O. Mendel


Joachim Wagner

Questions for Dr. Hartmut Pflaum – Head of the Resource Management Division at the Fraunhofer Institute UMSICHT

How many companies has your renowned institute investigated in a comparable CO₂ benchmarking?

Up to now we at the Fraunhofer Institute UMSICHT have only performed such a detailed and comprehensive analysis for the ALBA Group.

What did you take as the basis for your calculations?

We systematically analysed and then drew up a balance for all processes in close cooperation with all divisions of the ALBA Group. We took the latest figures from renowned institutes and reliable ecobalance databases as well as the Federal Statistical Office as a basis for our calculations of CO₂ savings. Our results are thus based on proven industrial standards to guarantee a high level of reproducibility.

What do you believe to be the most important results of your study?

First of all I would like to say that we placed great store by a conservative calculation. Thus, we only related the calculated data to one circuit in the business cycle and excluded any duplicate settlement between ALBA and Interseroh.

Nevertheless, we were impressed by how much CO₂ was saved through the recycling activities of the ALBA Group. Take aluminium, for example: if a company decides to use recycled aluminium from the ALBA Group, the CO₂ footprint is reduced by a good 10 tons of CO₂ for each ton of aluminium used. And the aluminium can be recycled with hardly any loss in quality. This is why we – and the political parties – should support the trend for using secondary raw materials.

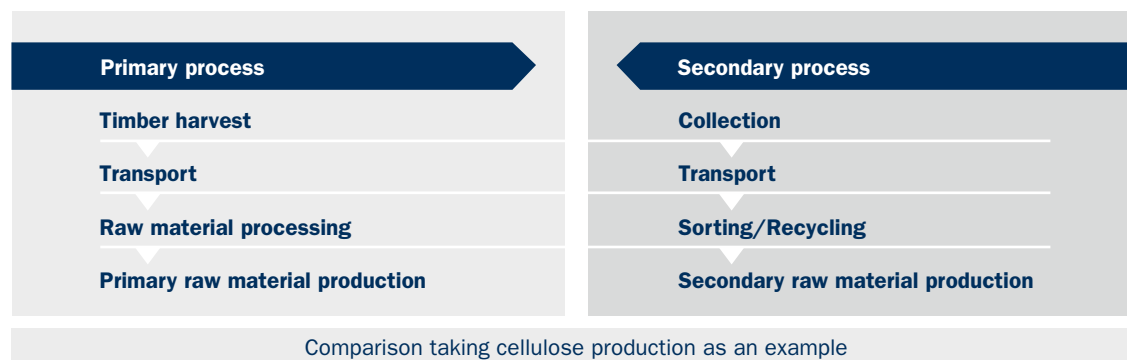


The **recycling** work of the ALBA Group has been proven to make an important contribution to **climate protection**.

CO₂ is the most common of the so-called greenhouse gases in Germany with a share of 87%: the sun's energy is trapped in the atmosphere like in a greenhouse and thus contributes to global warming. Around 550 billion tons of CO₂ are produced naturally around the world every year; the same amount is degraded by natural processes such as photosynthesis. However, a further 33 billion tons of CO₂ are set free each year by humans, e. g. through the combustion of fossil fuels in traffic or to generate electricity. There is no natural compensation for this additional amount.

Today's recycling spares natural resources and also has a very positive effect on the climate: the ALBA Group saved more than 6.2 million tons of CO₂ in 2010 through the material and energetic recycling of 6.4 million tons of recoverable materials. **Recycling and the generation of energy from recycling materials are thus two of the most efficient ways to lower CO₂ emissions and reduce the consequences of the greenhouse effect.**

This present study compares the manufacture of a product from secondary raw materials with its manufacture from primary raw materials. A primary process is understood as a process in which products such as paper, iron or energy are produced from primary materials. This includes all of the necessary logistics processes. The secondary process describes the production of a product (e. g. plastic granules) and generation of energy from recycling materials (e. g. from waste wood).



Valid results through conservative treatment

Materials such as paper or polyethylene can be recycled several times in principle. Metals can be recycled almost indefinitely. However, all of the calculations are based on only one circuit in the economic cycle so as to obtain comparable data. Consequently, each material fraction only receives the CO₂ credit for one recycling process. Duplicate counts were avoided by an intensive comparison of Interseroh and ALBA databases. In this study the following CO₂ balances were drawn up for the ALBA Group: **metals, old electrical equipment, plastics, lightweight packaging, paper, cardboard, boards, glass and wood**. The recycling of domestic and industrial waste by means of the **mechanical-physical stabilisation method (MPS)** was also investigated.

Positive and innovative

Apart from the positive overall result, the study also produced some interesting partial results. For example, metal recycling represents the biggest single item in the ALBA Group balance with over 4.0 million tons of CO₂ savings. And savings of over 10 tons of CO₂ for each ton of material produced makes aluminium recycling the absolute leader.

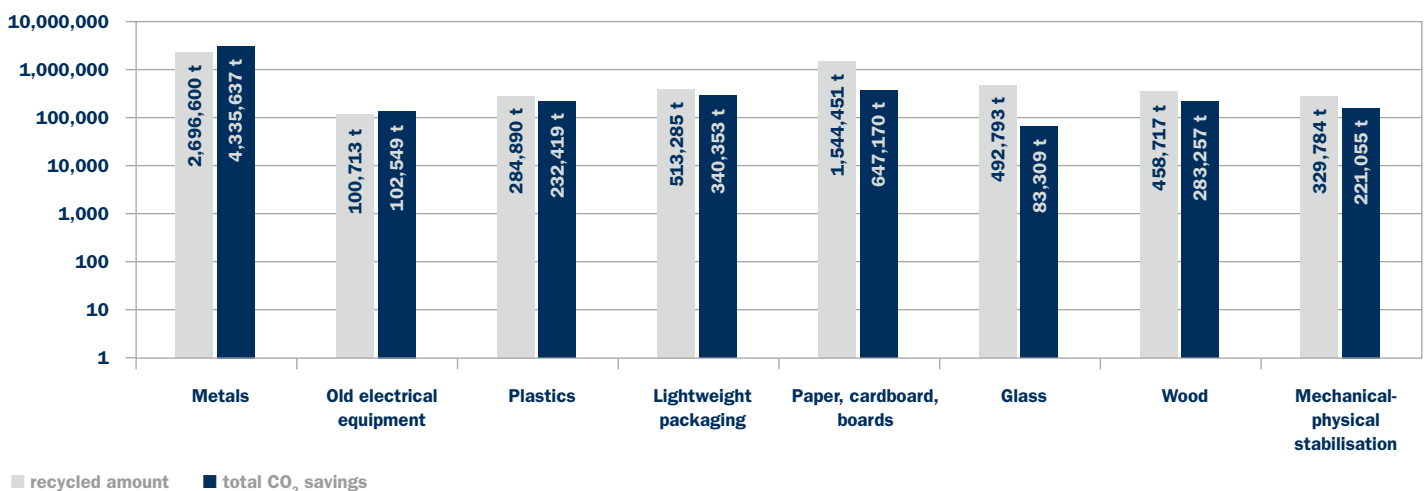
The progress made in the ability to sort mixed materials more reliably and thus recycle them better is also worth noting. For example, a much improved climate effect is noticeable with the use of the "Gelbe Tonne^{plus}" to extend waste collections without any logistical or technical modifications to include identical materials that are not packaging.



In total, the activities of the ALBA Group in 2010 saved over 6.2 million tons of CO₂ or 0.8% of the total German output of 765 million tons of CO₂.

A mixed European forest covering 6,244 km² would be needed to bond this amount of CO₂ – an area roughly seven times that of Berlin.

Savings in CO₂ emissions for the ALBA Group in 2010



Metal recycling profits from an almost constant quality of the secondary raw materials.

Metals are one of the non-renewable raw materials. Apart from the economic and ecological burdens from mining under increasingly difficult conditions, they have to be recycled if only on account of the limited resources. The ALBA Group made a substantial contribution here with around 2.7 million tons of recycled materials and savings of 4.3 million tons of CO₂. The study considered the CO₂ relief through recycling the metal fractions aluminium, steel and copper. This is primarily sorted scrap that can be recycled as often as you like with practically no loss of quality.

Aluminium

Aluminium is the most-used metal in the world after steel. 60% of the approx. 1 million tons from German production in 2010 came from recycling. Aluminium is the front-runner when it comes to CO₂ savings through recycling: with over **10 tons per ton of recycled material**, more than 85% of CO₂ is saved compared to its production from primary materials.

Aluminium recycling thus achieves an outstanding savings effect. The lower emissions due to the activities of the ALBA Group alone in 2010 amounted to 1.5 million tons of CO₂. This figure corresponds to the CO₂ capture of a European mixed forest of more than 1,500 km² – roughly the size of Mexico City.



Metals

Copper

Copper is usually found as a primary material in ores, though only in very low concentrations: its processing requires a large amount of energy. Around 13% of the copper processed in the world today already comes from recycled scrap copper, 54% in Germany. Energy and other environmental burdens are thus significantly reduced.

Recycling therefore **saves an amazing 3.52 tons of CO₂ for each ton of copper that is produced**, or 64% compared to the primary process. The ALBA Group saved a total of around 465,000 tons of CO₂ in 2010 through copper recycling. A European mixed forest covering around 450 km², roughly the size of the city of Prague, would be needed to bond these emissions.

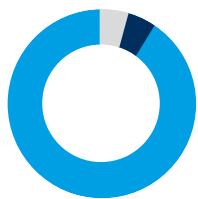


Steel

The worldwide production of steel in 2010 was around 1.4 billion tons, with Germany accounting for 43.8 million tons. The secondary raw materials share worldwide was 34% and in Germany 47%. Steel recycling also has a good CO₂ balance: **0.98 tons of CO₂ per ton of input material** or 64% of carbon dioxide emissions of the primary process can be saved.

By recycling 2.42 million tons of scrap steel, the ALBA Group thus reduced the CO₂ burden in 2010 by around 2.36 million tons. A European mixed forest of roughly 2,360 km² would be needed to bond this amount – an area roughly the size of Saarland.

Savings in CO₂ emissions through metal recycling in 2010



2,696,600 t
recycled amount

Aluminium 148,800 t
Copper 132,200 t
Steel 2,415,600 t



4,335,637 t
total CO₂ savings

Aluminium 1,508,688 t
Copper 465,410 t
Steel 2,361,539 t

Aluminium 35%
Copper 11%
Steel 54%



This corresponds to the annual CO₂ capture of a mixed forest covering 4,335 km² – an area slightly smaller than the Ruhr district.

Recycling **old electrical equipment** is today seen as a source of tomorrow's raw materials.

Germany was one of the first member states to implement the EU directive on the disposal of old electrical and electronic equipment in 2005 with the electrical and electronic equipment act (ElektroG). As a leading environmental services provider, the ALBA Group became involved in recovering valuable resources through the recycling of scrap electronic equipment at an early stage.

Nowadays the recycling of old electronic equipment has developed into an increasingly attractive source of raw materials. Because electronic scrap contains not only familiar precious metals such as gold, silver or platinum but also strategically important metals and rare earths. These include gallium, niobium, tantalum or neodium. Their special properties are nowadays the

basis for numerous key technologies, for example in mobile phones or in photovoltaic systems. The present study shows that the ALBA Group **saved an average of 1.02 tons of CO₂ per ton of old material** by recycling electronic scrap. On closer consideration, one can differentiate between four collection groups:

Old electrical equipment: collection groups and categories in the ALBA Group

Large electrical equipment	Large household devices such as washing machines and tumble dryers (without fridges)	Savings: 1.09 t CO ₂ *; 66%**
Refrigerators	Fridges and deep freezers	Savings: 0.91 t CO ₂ *; 57%**
Video terminals	TVs and monitors	Savings: 0.24 t CO ₂ *; 36%**
Small electrical equipment	Small household devices such as toasters, razors, vacuum cleaners and mobile phones	Savings: 1.48 t CO ₂ *; 69%**

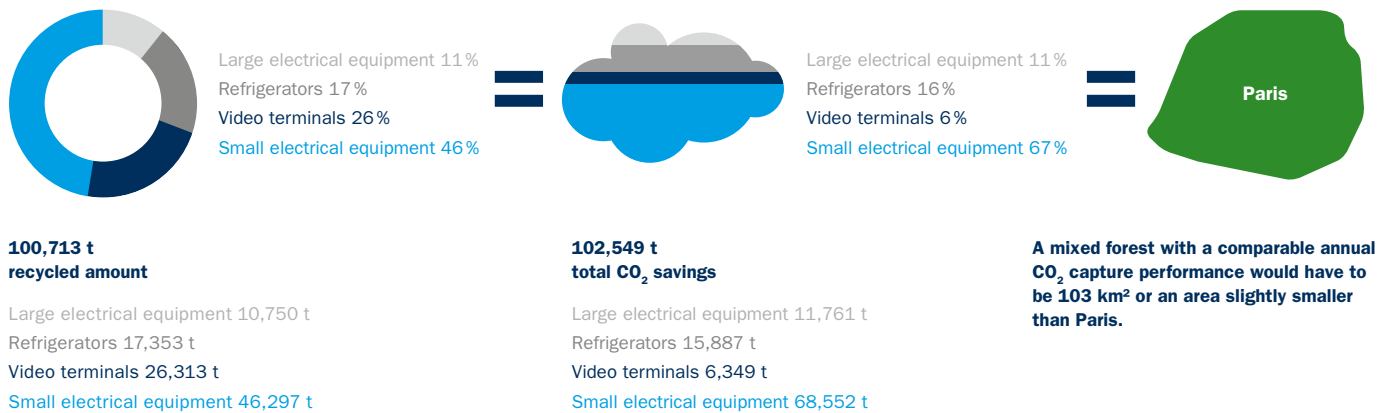
* Per ton of old material.

** Percentage reduction of CO₂ emissions compared to primary production of the individual fractions.

Old electrical equipment



Savings in CO₂ emissions through the recycling of old electrical equipment in 2010





Sustainable recycling is becoming increasingly important for **plastics**.

It was long thought that energy recovery was the only worthwhile recycling method for old plastics. But the rising price of crude oil, the introduction of deposits on non-refillable containers and a growing interest in sustainable actions have led to a steady rise in material recycling in Germany since around 2003.

Energy recovery is still slightly above material recycling (63%). But only the energy bound in plastic by crude oil is recycled. Methods that initially recycle the plastic material to allow its further use are much more sustainable. The CO₂ savings are then much more positive compared to a simple energy recovery.

Thanks to innovative process-engineering technologies, the ALBA Group can already recycle 70% of the plastic wastes it collects. So-called upcycling is becoming increasingly important: old material is used to produce new plastics whose quality sometimes even exceeds that of the input products.

Polyethylene (PE)

Polyethylenes are a group of plastics that are used as films, containers or fibres, for example, and for the injection moulding of components such as tubes and gear wheels. PE can be recycled by modern methods with no problems; **an average of 0.66 tons of CO₂ are saved for each ton of material**, corresponding to a reduction of CO₂ emissions of 46% compared to the primary process.

The ALBA Group thus saved a total of 114,481 tons of CO₂ in 2010 by recycling PE plastics.



Polyethylene terephthalate (PET)

PET is known as a material for disposable bottles and other food packagings. But the plastic is also used elsewhere, for example in fleece materials for breathable sports and leisure textiles, airbags, safety belts or allergen-free pillows. Recycling PET allows **savings of up to 1.2 tons of CO₂ per ton of material**, corresponding to a 65% reduction of CO₂ emissions compared to production from primary resources.

The system of deposits on non-refillable containers has proven particularly beneficial for recycling: large quantities of used PET are collected separately in Germany and can therefore be recycled very economically. In 2010 the ALBA Group saved a total of 104,498 tons of CO₂ by recycling PET.

Plastics

Polypropylene (PP)

Polypropylene is a versatile material that can be used for household packaging and textile fibres though just as well for heavy-duty products such as car batteries or safety helmets. The recycling cycles of PP are almost unlimited too. The **CO₂ savings are 0.48 tons per ton of material**, corresponding to 40% lower CO₂ emissions than the primary process.

Total savings of the ALBA Group with PP plastics in 2010 was 3,553 tons of CO₂.



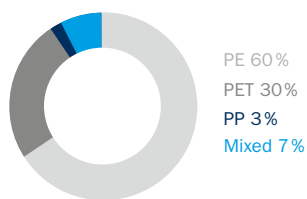
Mixed plastics

Mixed plastics are produced in many fields of waste disposal. Apart from the separately collected PE, PP and PET fractions, they cover a variety of other plastics.

Mixed plastics were investigated as a material flow at ALBA. Their recycling results in a **saving of 0.5 tons of CO₂ per ton of material** or 63% lower CO₂ emissions compared to the primary process. In 2010 the ALBA Group could therefore save 9,887 tons of CO₂ in this field.



Savings in CO₂ emissions through plastic recycling in 2010



284,890 t
recycled amount

PE 172,263 t
PET 84,903 t
PP 7,366 t
Mixed 20,358 t

=



232,419 t
total CO₂ savings

PE 114,481 t
PET 104,498 t
PP 3,553 t
Mixed 9,887 t

=



This results in an annual CO₂ capture for which a mixed forest covering 232 km² would be needed – an area slightly larger than Frankfurt on the Main.

New sorting technologies make **lightweight packaging** more and more attractive as a resource.

Lightweight packaging, or LP for short, are materials that are collected in the “Yellow bin” or “Yellow bag” in Germany, mainly tin foil, aluminium, composite drinks packaging, other composite materials on a paper basis and plastics. So-called same-substance non-packaging such as plastic toys or cooking pots and small electrical equipment are also collected in the “Gelbe Tonne^{plus}”.

The main challenge with this material flow lies in the reliable, efficient separation of the material fractions. Complex technologies are used at present. For example, ALBA uses computer-assisted NIR separation based on infrared light in high-tech sorting plants, the most up-to-date technology of its kind in Europe.

Within the scope of LP recycling the ALBA Group not only operates numerous separation plants but also licenses the Interseroh Dual System. The Interseroh Dual System ensures that the marketed quantities are collected, sorted and returned to the recovered substance cycle. Quantities recycled by ALBA* on behalf of the Interseroh Dual System are strictly defined and thus only considered in the study at this point. The resulting CO₂ balance in both cases relates to the savings made over the complete recycling process. All material collected together with the LP including impurities were taken into account. ALBA Group's work in 2010 thus resulted in total CO₂ savings of 304,353 tons.

ALBA

We calculated **savings of 0.47 tons of CO₂ per ton of material** for the recoverable materials sorted by ALBA relative to the overall recycling process. This led to a 63% reduction of the CO₂ emissions compared to the primary production of the individual materials. With a total quantity of 316,064 tons of sorted LP, ALBA's work thus contributed to savings amounting to 147,551 tons of CO₂ in 2010. The mixed forest comparison results in an area of 148 km².

Interseroh Dual System

The Interseroh Dual System led to average **savings of 0.98 tons of CO₂ per ton of licensed material**** in 2010 for lightweight packaging. Since the Interseroh Dual System collected and recycled a higher quantity of LP in 2010 than was licensed, the savings factor was adjusted upwards. With a licensed quantity of 197,221 tons of LP this means total savings of 192,802 tons of CO₂, corresponding to the CO₂ capture of a European mixed forest covering 193 km².

* On behalf of other system providers too.

** Relative to the sorted LP ton, the figure is 0.46 tons of CO₂ per ton of material.

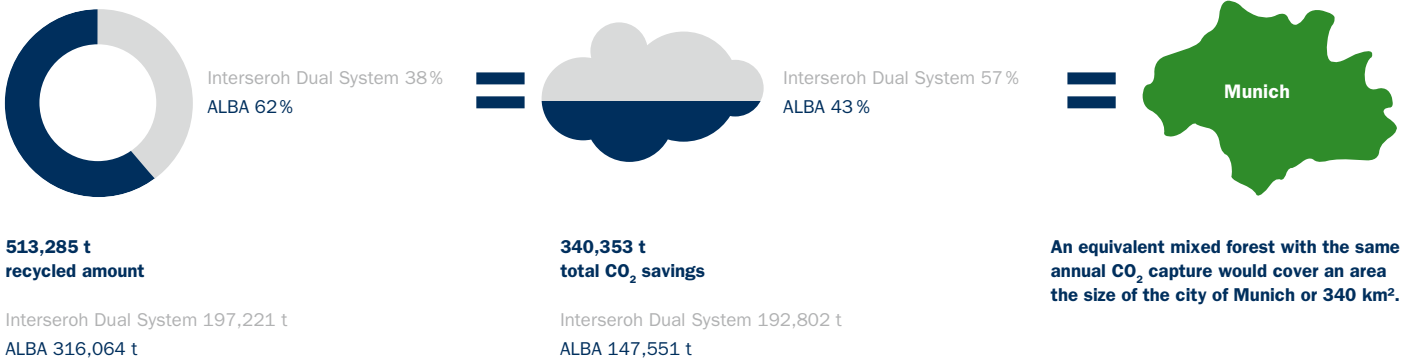


“Gelbe Tonne^{plus}”

The “Gelbe Tonne^{plus}” is a further development of the “Yellow bin” that was successfully introduced by ALBA in Berlin and Leipzig. Same-substance articles of metal, plastic and composite materials as well as wood and small electrical equipment such as razors, hairdryers or electric toothbrushes are collected in these along with packaging. There is a positive economical and ecological effect inasmuch as all of the recoverable materials from the “Gelbe Tonne^{plus}” can be processed in existing sorting and recycling plants.

The “Gelbe Tonne^{plus}” system on the whole leads to a better collection of dry recoverable materials and old electrical equipment: **around 6 kg of additional recoverable materials are collected per inhabitant and year**. The potential CO₂ savings rise by around 30% per inhabitant and year compared to conventional LP collections commensurate with this positive balance.

Savings in CO₂ emissions through the recycling of lightweight packaging* in 2010



*The calculation of the CO₂ savings in 2010 relates exclusively to conventional collections with the “Yellow bin” and “Yellow bag”.

Recycling the classic materials **paper, cardboard, board** and **glass** profits from modern processes.

Around 23 million tons of paper, cardboard and board (PPK) were produced in Germany in 2010; around 70% of this came from old material. The best possible sorting is also a prerequisite for top-quality recycling here. Modern methods allow the ALBA Group to separate key partial fractions by purely mechanical means, leading to savings of more than 640,000 tons of CO₂ in 2010.



Apart from the general PPK collection systems from ALBA and Interseroh, Repasack, the sustainable take-back system for used paper bags, was also taken into account for this fraction.

Average **CO₂ savings of 0.42 tons per ton of old material** were calculated for the divisions in the ALBA Group that are active in the PPK sector, corresponding to an 87% reduction compared to the primary process. A total of 1.5 million tons of PPK were recycled, leading to a total reduction of the CO₂ burden of almost 640,000 tons.

Savings in CO₂ emissions through the recycling of paper, cardboard and board in 2010



1,544,451 t
recycled amount

Interseroh* 276,716 t
ALBA 1,267,735 t



647,170 t
total CO₂ savings

Interseroh* 93,614 t
ALBA 553,556 t



A mixed forest covering 647 km² would be needed for a comparable annual CO₂ capture – in other words an area slightly larger than that of the city Madrid.

*Recycled quantities and corresponding CO₂ savings for Repasack and the Interseroh Dual System were credited to Interseroh.

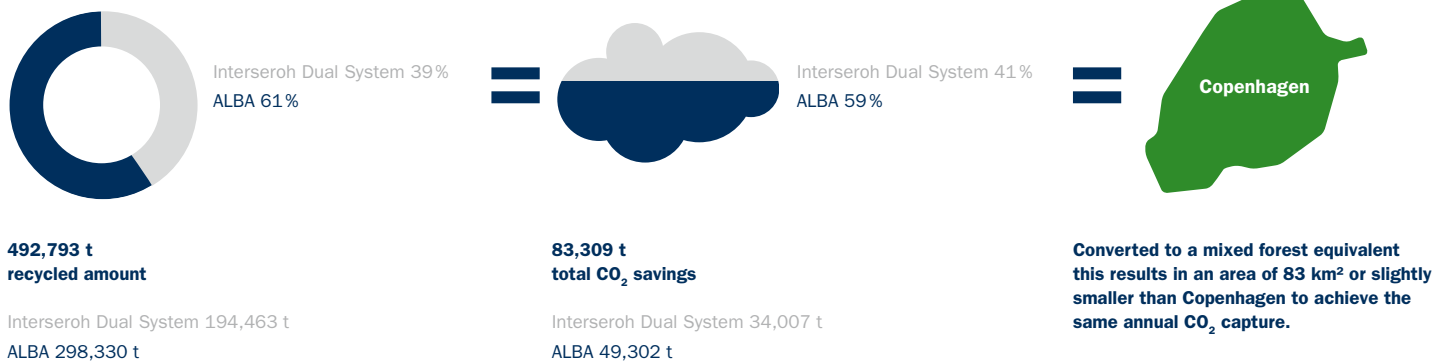


3.8 million tons of container glass were produced in Germany in 2010, around 60% of which came from recycled old glass. This high share was supported by better and better sorting and separating methods, with the ALBA Group playing a leading role. Even the smallest grains of glass measuring only 5 millimetres were collected and impurities such as ceramics or wrong colours were reliably eliminated.

Old glass is an ideal secondary raw material that can be recycled without problems. New bottles can be produced almost completely from shards with no loss of quality. One prerequisite is an optimum purity of the fine granulate that can be used with no further processing by the glassworks. The old glass sorted and processed by the ALBA Group satisfies the highest of requirements. But the eliminated impurities are also recycled: the ALBA Group forwards them to the processors of the relevant materials from where they are returned to the raw materials cycle.

Consequently, the ALBA Group recycled a total of more than 493,000 tons of old glass* in 2010 and thus reduced the burden on the atmosphere by more than 83,300 tons of CO₂. The **CO₂ savings amounted to 0.169 tons per ton of old material** corresponding to an 86% reduction compared to primary production.

Savings in CO₂ emissions through glass recycling in 2010



*On behalf of other system operators too.

The recovery of fuels and recycling of **wood** make an important contribution to climate protection.

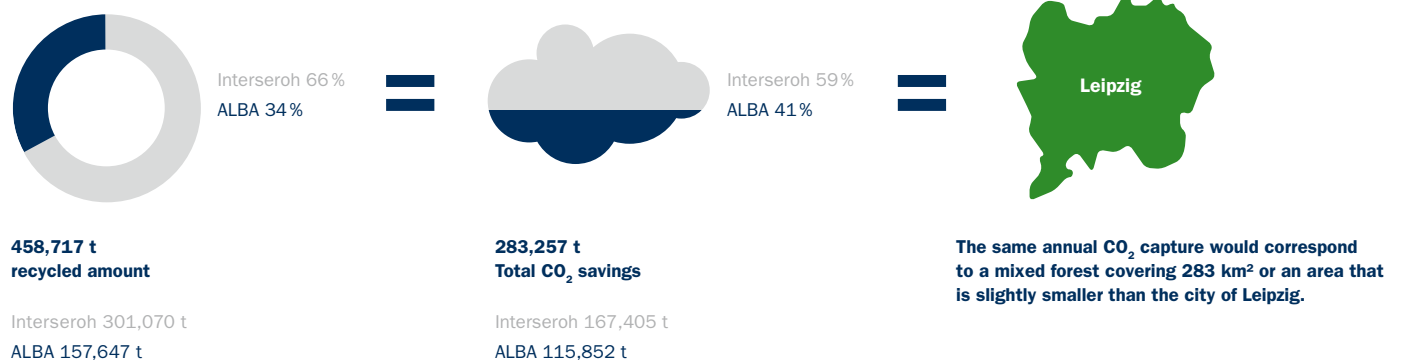
The total volume of wood in 2010 in Germany was 235.7 million m³*. Old wood accounted for around 11 million m³ or 4.7%. Old wood hereby serves as a CO₂ neutral fuel within the scope of a climate-friendly energy supply: the CO₂ released by energy recovery has been bound in wood naturally through photosynthesis.

Old wood can also be recycled, e. g. to produce chip-board, though only higher quality woods can be used in this case. Woods of a lower quality or old wood that is contaminated with pollutants are recycled by means of pyrolysis or similar methods.

The CO₂ savings through secondary use in 2010 were 0.56 tons for Interseroh and 0.74 tons per ton of old wood for ALBA. The ALBA Group recycled a total of 459,000 tons of old wood in 2010, saving almost 283,000 tons of CO₂.



Savings in CO₂ emissions through wood recycling in 2010



*m³ (r), so-called raw wood equivalent: figure for a comparison of mixed fractions.

Production of climate-friendly fuels through **modern process engineering technology.**

Mechanical-physical stabilisation (MPS) is a method to recover substitute fuels from domestic and garden wastes and is regarded as the most innovative ecological waste treatment method. The ALBA Group has built two of Europe's most up-to-date MPS plants for environmentally compatible and economical waste treatment in Berlin and is also responsible for marketing the products.

The substitute fuels produced by MPS (55% of the amount) are used for co-combustion in cement works or power stations and substitute in particular the "climate killer" brown coal. Advantages of the MPS method include the needs-based production of fuels of a constant quality and short processing times. Up to 98% of residual wastes can be used. The predominantly biogenic share of more than 70% of the carbon ensures a high CO₂ neutrality.

In concrete figures, MPS **saves 0.7 tons of CO₂ per ton of domestic waste and 0.8 tons of CO₂ with industrial wastes.** The total CO₂ savings in 2010 in Berlin amounted to 220,000 tons.



Savings in CO₂ emissions through MPS in 2010





Contact

ALBA Group plc & Co. KG
Bismarckstraße 105
10625 Berlin

INTERSEROH SE
Stollwerckstraße 9a
51149 Cologne

co2studie@albagroup.de
www.albagroup.de