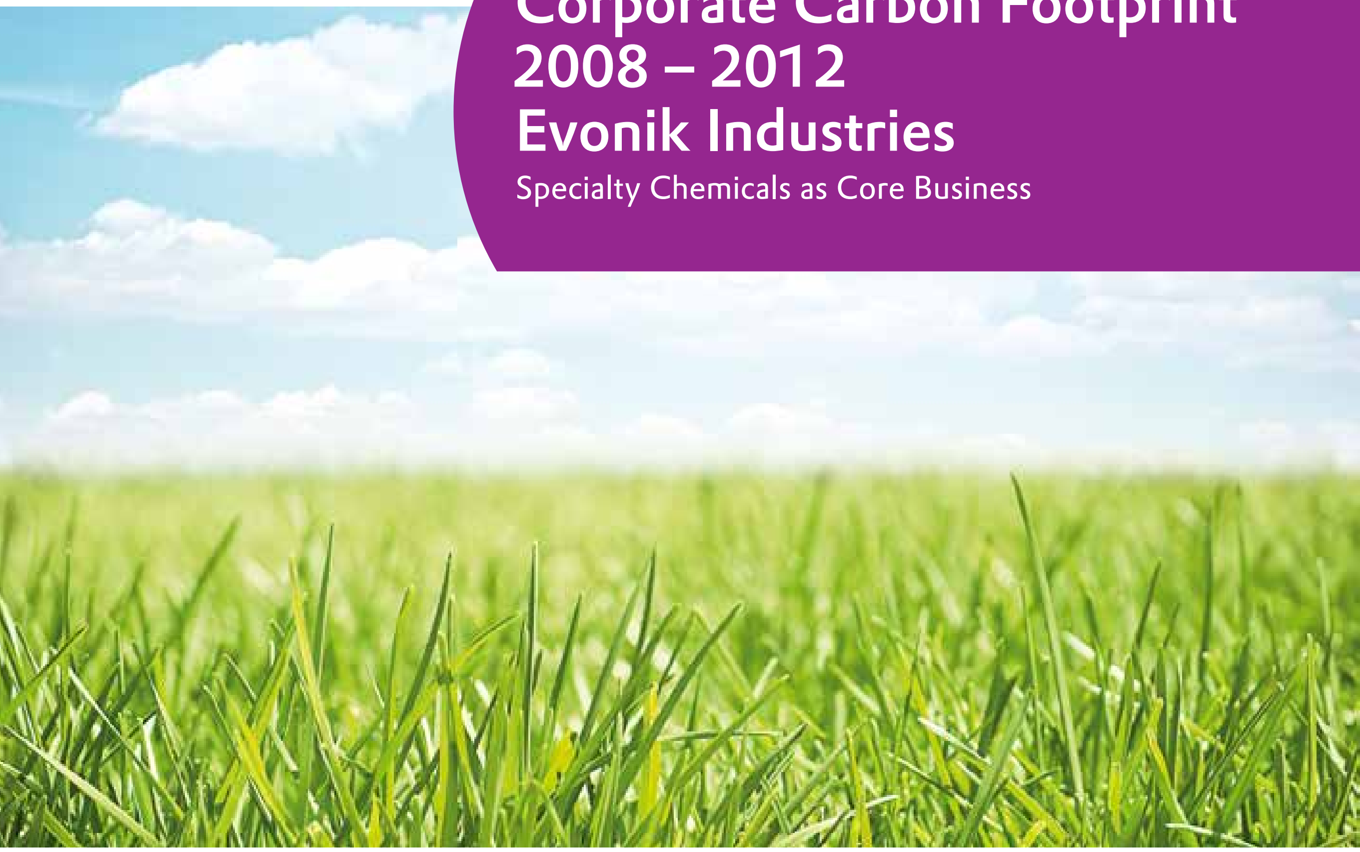
Corporate Carbon Footprint 2008 – 2012
Evonik Industries

Specialty Chemicals as Core Business



Evonik. Power to create.

Content

Corporate Carbon Footprint of Evonik Industries, Specialty Chemicals as Core Business

1 Summary

Evonik Industries (hereinafter "Evonik") takes responsibility not only for its business and employees, but also for the environment and society. In addition to data on direct greenhouse gas emissions in its specialty chemicals core business, Evonik has consistently been compiling information on indirect greenhouse gas emissions and their distribution over various emission sources along the supply chain for select relevant categories since 2008. This has resulted in a greenhouse gas balance for the most important lifecycle phases of products by Evonik, covering the entire range from raw material extraction to production and ultimate disposal.

The methodology of the report is guided by the "Greenhouse Gas Protocol Corporate Standard" ("GHG Protocol") of the World Resources Institute (WRI) and the World Business Council for Sustainable Development (WBCSD)[1]. The most relevant indicator is the so-called carbon footprint or CO_2eq footprint, which reflects the volume of greenhouse gas emissions (CO_2 equivalents, meaning CO_2 and other greenhouse gases defined in the GHG Protocol Corporate Standard) for a company, a process, or an individual product. This balance report exclusively covers the greenhouse gas emissions of the specialty chemicals core business of Evonik. Other potential environmental impacts, including impacts on health and safety, are analyzed in other projects carried out at Evonik.

The development of greenhouse gas emissions of the specialty chemicals core business is shown in the table below, not including the use phase of products by Evonik.

The drop in greenhouse gas emissions in 2012 is essentially due to smaller raw material volumes. Furthermore, the volume of renewable resources with low emission factors increased slightly, accompanied by a parallel reduction of raw material purchases.

Evonik reached the highest quality level when it participated in the Carbon Disclosure Project (CDP, mid-sized business initiative) for the first time last year and was recognized for its outstanding result in disclosure scoring at the CDP annual conference. The evaluation focused on the completeness of climate reporting, which is considered an indicator for the usability of data. With a score of 81 points, Evonik was among the top twenty percent of all participating companies from the region of Germany, Austria, and Switzerland. Evonik plans to submit the figures compiled for this report to the CDP for 2012.

The Group's internal Life Cycle Management (LCM) team is responsible for the compilation of greenhouse gas emission data. This team defines itself as a neutral and strategic partner on the issue of sustainability, with the goal of supporting Evonik on its way to becoming a more sustainable company.

[1] World Resources Institute, World Business Council for Sustainable Development: The Greenhouse Gas Protocol. A Corporate Accounting and Reporting Standard. (Revised Edition 2004)

The balance included energy and process emissions of Evonik, company vehicles and heating, ventilation and air-conditioning of buildings (Scope 1), purchased electricity and heat (Scope 2), purchased feedstocks, inbound and outbound transports, employee commuting, business travel as well as disposal and recycling (Scope 3) (see Figure 1). The balance did not include the use phase of products by Evonik. The balance sheet for 2009-2012 does not include the Carbon Black unit, which was divested in 2011. The 2008 data listed for comparison reflect the scope of consolidation of the core business specialty chemicals (as of December 31, 2008) and include Carbon Black.

Table 1: Development of greenhouse gas emissions along the supply chain of Evonik Industries, core business specialty chemicals, not including use phase (2008 data include Carbon Black; Carbon Black not included from 2009) [2]

	2008	2009	2010	2011	2012
CO_2eq emissions in million metric tons	25.2	20.2	23.5	22.9	22.2

[2] Thanks to improvements in the data quality after 2009, further details were available for the externally purchased quantities of chemical feedstocks, which led to a retroactive adjustment of the calculated Corporate Carbon Footprint values for 2009-2011. The 2008 values are still based on the original data.

2 Methodology

The GHG Protocol provides the methodological framework for calculating the Corporate Carbon Footprint of Evonik (in the core business specialty chemicals). It contains a guideline for quantifying and reporting greenhouse gases. Greenhouse gases are converted with the help of the specified equivalence factors[3] and then summarized as CO_2 equivalents (CO_2eq).

2.1 Organizational boundaries

The Corporate Carbon Footprint of Evonik was calculated in accordance with the full consolidation approach for the core business specialty chemicals, which was chosen to match the financial and environmental reporting of Evonik. Evonik is aware of the fact that this approach can lead to double-counting of greenhouse gas emissions were two or more companies holding shares of the same legal entity report their emissions.

[3] Intergovernmental Panel on Climate Change (IPCC): Fourth Assessment Report (AR4): Climate Change 2007 - The Physical Science Basis, Chapter 2, Table 2.14

2.2 Operational boundaries

The Corporate Carbon Footprint of Evonik is calculated based on the principles of the GHG Protocol, following the scope concept of operational boundaries[4] (see Figure 1).

Scope 1 covers the direct emissions of Evonik, while the indirect emissions from purchased electricity and heat for company use are combined in Scope 2 and those from other emission sources in Scope 3.

Scope 1 emissions from production processes as well as the Scope 2 emissions are already part of the existing Environment, Safety, Health, Quality (ESHQ) reporting of Evonik. Evonik's environmental data are collected in the Sustainability Reporting (SuRe) system, which covers all data that are required for the regulatory reporting by Evonik. In addition to Scope 1 and 2 emissions that are recorded in the SuRe system, this balance sheet also includes emissions from the use of company cars and the heating, ventilation, and air conditioning (HVAC) of administrative buildings.

The Scope 3 data of Evonik include emissions caused by production and transport of chemical source materials, product transport to Evonik customers, disposal and recycling of products by Evonik as well as commuting and business travel of employees.

The following specific calculation approaches, based in part on estimates and assumptions, were used to determine greenhouse gas emissions within the different scopes:

CO_2eq burden of chemical raw materials

The calculation of the CO_2eq burden is based on a list of all chemical raw materials provided by Evonik Procurement. The individual raw materials of this list were totaled in categories. Because of the multitude of raw materials used by Evonik, these categories–and not the raw materials themselves–served as the

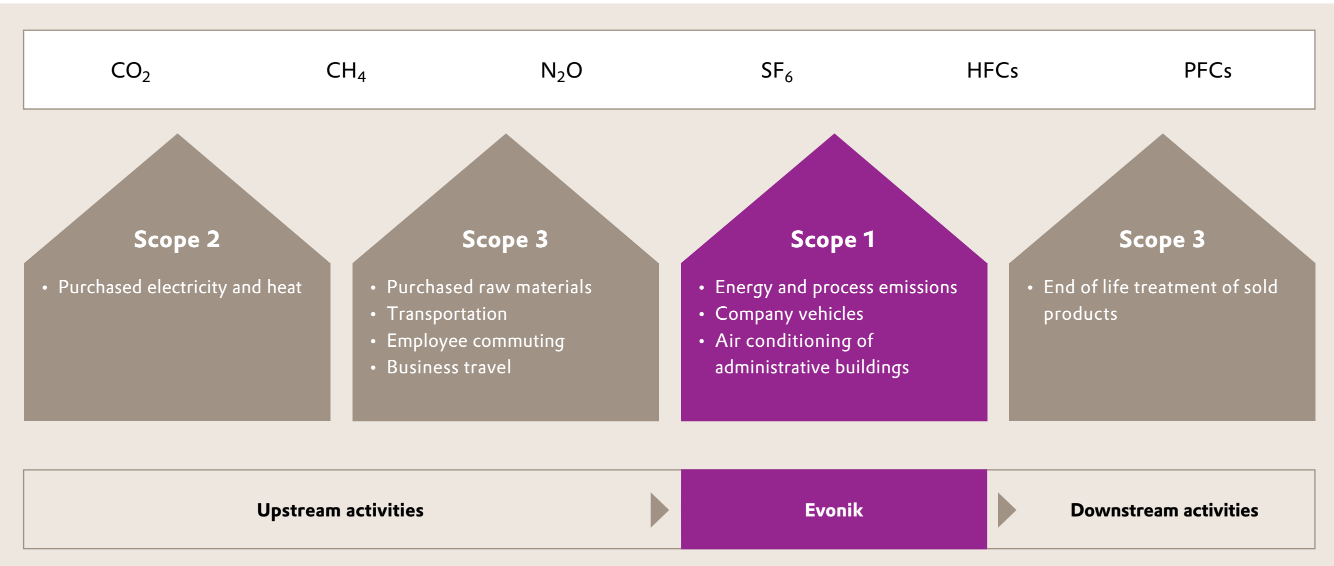


Figure 1: Overview of captured scopes and emissions along the supply chain

[4] See GHG Protocol (http://www.ghgprotocol.org) for further details on the definition of principles and scopes

basis for evaluating the CO_2eq burden. This included the 100 most frequently purchased raw material categories by volume. An extrapolation of greenhouse gas emissions was performed on the basis of raw material volumes. PE International AG[5] then identified the current emission factors of the GaBi 5 database (version dated early 2013) that could be used to calculate the CO_2eq burden with consideration for purchased volumes. In cases where emission factors of specific substances were unknown, PE International AG estimated an emission factor based on similar products or applied an appropriate mean emission factor where this estimate appeared inaccurate.

An additional calculation performed in 2012 analyzed the 100 most cost-intensive raw materials in terms of their purchase price per metric ton. It was based on the assumption that a high source material price may reflect relevant greenhouse gas emissions in the prior supply chain, for example because of high energy use. However, results documented that the 100 most costly raw material categories are not relevant for the determination of greenhouse gas emissions of Evonik because of their small quantities, although some had high emission factors.

Inbound transports of chemical raw materials

As far as possible, the average transport distance categories used in 2008 were used to determine the emissions caused by inbound material transports. The transport emission factors were borrowed from the European Chemical Industry Council (CEFIC)[6]. Since these emission factors do not include the CO_2eq burden for fuel, an additional share was included. A mean transport emission factor was calculated from the 2008 transport data for raw material categories not associated with any transport information. Transport emissions were determined for the 100 largest raw material categories by volume, with an extrapolation of the resulting greenhouse gas emissions performed on the basis of volume.

Calculation of emissions caused by commuting

The emissions caused by commuting to and from work were calculated on the basis of the following conservative assumptions: a majority share of Evonik employees who individually commute by car, daily traveling distance, a certain number of working days, and a high emission factor per kilometer driven from the GaBi database.

Calculation of emissions caused by business travel

The CO_2e emissions caused by business travel were calculated on the basis of data about travelling distances provided by Travel Management, using the corresponding emission factors for all means of transport. The calculation of greenhouse gas emissions was performed in Germany and was extrapolated based on the global number of employees.

Calculation of emissions from company cars (w/o utility vehicles)

The CO_2eq emissions of Evonik company cars were calculated using data about the average distance travelled, the total number of company cars, manufacturer data on CO_2eq emissions (with 25% added) and additional allowances for car manufacturing and the provision of fuel. Again, this calculation was performed for Germany and was extrapolated based on the global number of employees.

Calculation of emissions from heating, ventilation, and air-conditioning of administrative buildings

CO_2eq emissions from heating, ventilation, and air-conditioning of administrative buildings are already included in the SuRe system and accordingly, in Scope 1 and Scope 2 emissions for production

[5] PE International AG, Hauptstraße 111-113, 70771 Leinfelden-Echterdingen, Germany, http://www.pe-international.com
[6] McKinnon, Prof. Alan; Piecyk, Dr. Maja: "Measuring and Managing CO_2 Emissions of European Chemical Transport," Logistics Research Centre, Heriot-Watt University, EDINBURGH, UK, 2011

facilities that are subject to regulatory CO_2eq reporting requirements. At purely administrative sites, greenhouse gas emissions were determined based on the extrapolation of data collected at several relevant sites.

Outbound transports of chemical products

The CO_2eq emissions of outbound chemical product transports were also calculated with CEFIC emission factors, using the same methodology as the calculation for raw material transports. The calculations were based on total outbound volumes, average transport distances, and the selected means of transport.

End-of-life emissions of products after use

The emissions caused by the disposal of products by Evonik were calculated with the steps outlined below. Since Evonik does not always know the final application of its products, end-of-life emissions were not calculated for the applications per se, but only for their share of products by Evonik. That means disposal emissions were calculated exclusively for product volumes sold by Evonik, not for the applications produced from them with the help of third-party raw materials. CO_2eq emissions were calculated based on emission factors for the following disposal methods:

- Recycling
- Sanitary and open landfills, and
- Incineration with and without energy recovery.

Continent-specific percentage averages were calculated for every disposal method, which were then applied to the relative shares of all products sold by Evonik in 2012 on each continent.

CO_2eq emissions for disposal were calculated on the basis of the sales volume of each product line and the corresponding emission factors. Additionally, specific calculations were performed for certain product lines in which products are clearly not disposed in conventional ways (e.g., using stoichiometric calculations).

The above-described approach for calculating greenhouse gas emissions does not reflect infrastructure measures, such as the construction of facilities, machinery, roads, or IT equipment.

3 Results

3.1 Greenhouse gas emissions along the supply chain of Evonik Industries, core business specialty chemicals

The total CO_2eq emissions of Evonik along the supply chain in 2012 amounted to 22.2 mi llion metric tons of CO_2eq (see Table 2). The highest share of the emissions came from the burden of the chemical source materials in Scope 3, followed by the direct emissions of Scope 1 and the end-of-life emissions in Scope 3.

Compared to 2009, the rise production volume after the global economic crisis has caused generally higher levels of CO_2eq emissions. Evonik saw significant increases in demand in Asia and Europe, but also in North America. In 2011, the company achieved a slight reduction of CO_2eq emissions along the supply chain in spite of consistently high consumer demand. Both raw material purchases and sales volumes dropped slightly in 2012 compared to 2011. This led to a drop in the greenhouse gas emissions caused by the production of raw materials and product disposal.

Table 2: Development of greenhouse gas emissions along the supply chain of Evonik Industries, core business specialty chemicals, not including use phase (2008 data include Carbon Black; Carbon Black not included from 2009) [7]

	2008	2009	2010	2011	2012
CO_2eq emissions in million metric tons	25.2	20.2	23.5	22.9	22.2

[7] Thanks to improvements in the data quality after 2009, further details were available for the externally purchased quantities of chemical feedstocks, which led to a retroactive adjustment of the calculated Corporate Carbon Footprint values for 2009-2011. The 2008 values are still based on the original data.

Figure 2: Corporate Carbon Footprint of Evonik in 2008 [in mil. mt CO_2eq], *As of 12/31/2011

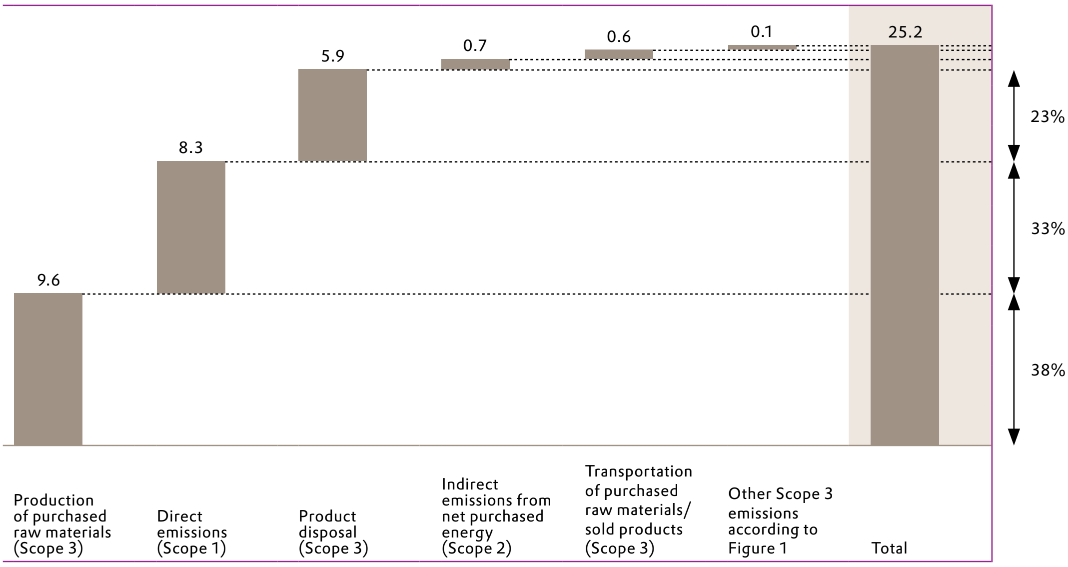
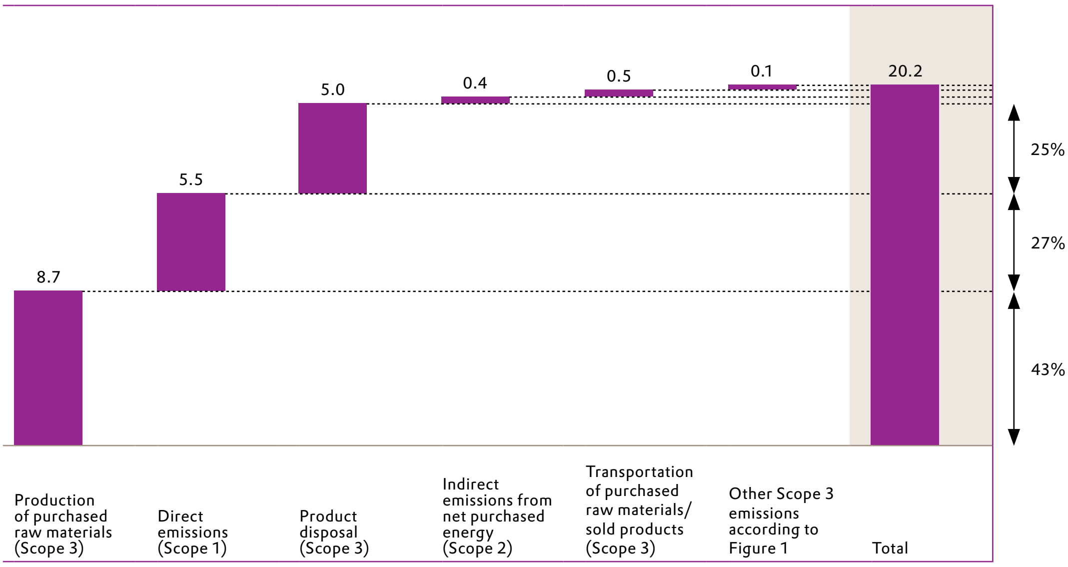


Figure 3: Corporate Carbon Footprint of Evonik in 2009 [in mil. mt CO_2eq], *As of 12/31/2011 (excluding Carbon Black)



Continued and non-continued activities

Continued activities

Figure 4: Corporate Carbon Footprint of Evonik in 2010 [in mil. mt CO_2eq], *As of 12/31/2011 (excluding Carbon Black)

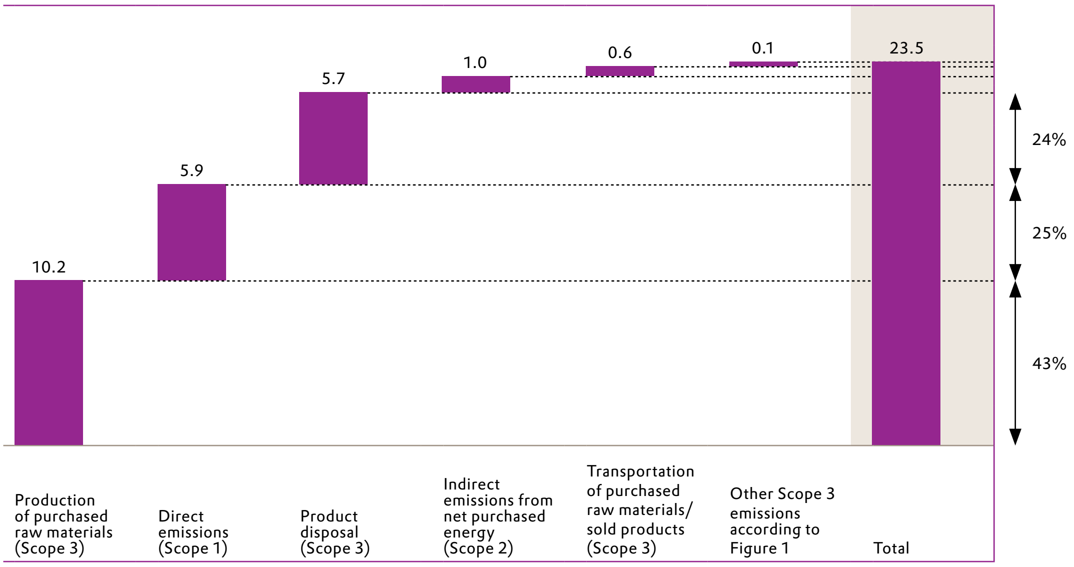


Figure 5: Corporate Carbon Footprint of Evonik in 2011 [in mil. mt CO_2eq], *As of 12/31/2011 (excluding Carbon Black)

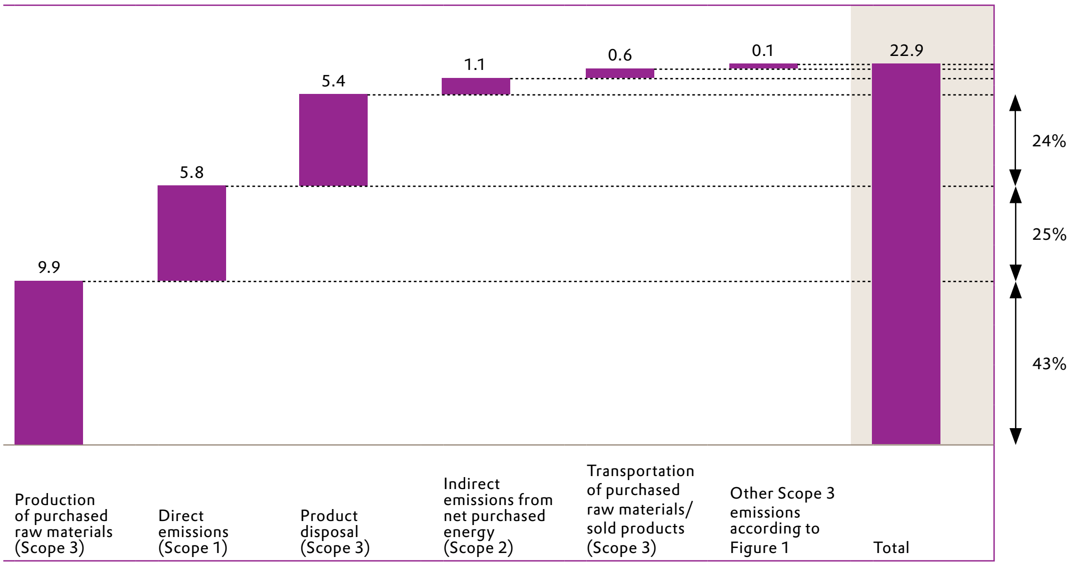
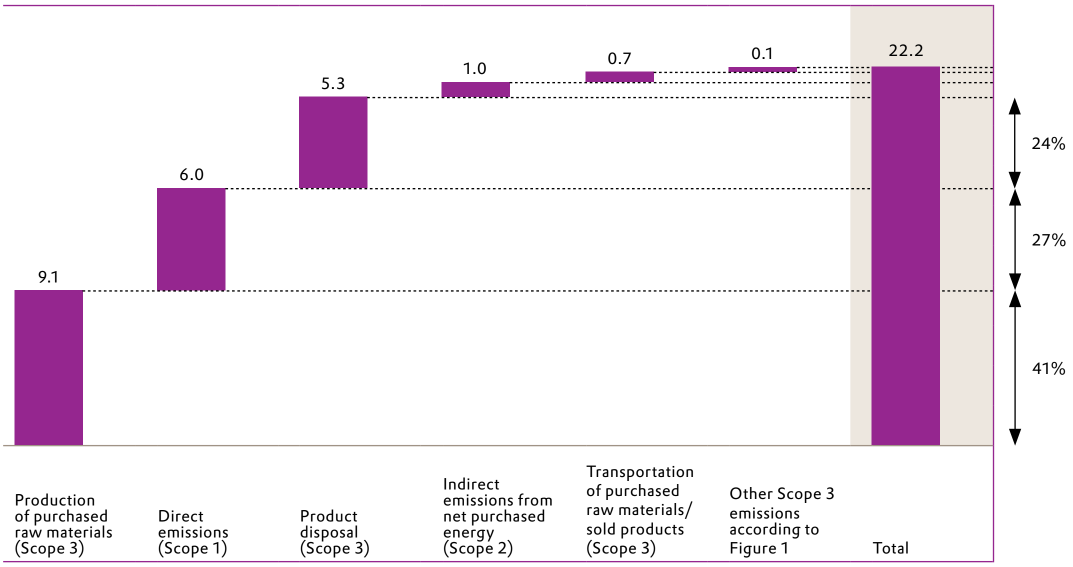


Figure 6: Corporate Carbon Footprint of Evonik in 2012 [in mil. mt CO_2eq], *As of 12/31/2012 (excluding Carbon Black)



CO_2eq reductions from the use of products by Evonik

1 Summary

Evonik offers numerous products that—compared to alternatives established on the market—cause greenhouse gas reductions in their applications. In light of the thousands of products manufactured by Evonik, savings in greenhouse gas emissions were calculated only for certain "beacon products," which were selected in a screening process with consideration for the strategy of the corresponding business units. Compared to their established alternatives, these beacon products save the volumes of greenhouse gases shown in Table 3.

In large part, these reductions are caused by the applications of the following four products: "green tire" technology, amino acids in animal feed, foam stabilizers for insulation materials, and specialty oxides in compact fluorescent lamps. Savings were generated over the life cycle of applications that are manufactured with the product volumes sold by Evonik in the specified year.

The decline of greenhouse gas emission savings from 2008 to 2009 is attributable to reduced sales volumes associated with the global economic crisis and to the adjustment of the Evonik share in the calculation of product-related savings based on more recent insights. The increase of reductions from 2009 is mainly due to increases in sales volumes.

These CO_2eq savings cannot be compared directly to the Corporate Carbon Footprint of Evonik, since it refers to emissions associated with the manufacture of products by Evonik (generally intermediates) (incl. both production and supply chain emissions, without use phase). By contrast, reductions have been calculated based on the life cycle emissions of applications of select products by Evonik.

The Group's internal Life Cycle Management (LCM) team is responsible for the compilation of greenhouse gas emission savings. This team defines itself as a neutral and strategic partner on the issue of sustainability, with the goal of supporting Evonik on its way to becoming a more sustainable company.

Table 3: Development of greenhouse gas emission savings over the life cycle of applications of select products by Evonik that were sold in the specified year

	2008	2009	2010	2011	2012
CO_2eq emissions in million metric tons	43.5	38.3	45.1	47.1	50.1

2 Methodology

Life cycle emissions are typically calculated with Life Cycle Assessments (LCA) according to DIN ISO 14040ff. Since LCAs are time and resource-intensive, they are not generated for all products by Evonik. If no LCA is available for a beacon product application, the calculation of emissions and reductions is guided by the externally reviewed Carbon Footprint Estimation (CFE) method, primarily on the basis of emission factors from the LCA software GaBi[8] used by Evonik.

The CFE model was developed as a method for evaluating early project and research ideas in terms of their greenhouse gas emissions as well as for calculating CO_2eq emissions and savings of products or processes without the need to perform detailed life cycle assessments. The methodology of a CFE resembles that of an LCA with some simplifications. Compared to a full LCA, however, CFE focuses only on the greenhouse effects of products and processes. More detailed information about the final CFE model can be found in the Evonik brochure “Carbon Footprint Estimation—A model for the evaluation of potential climate impacts of new product ideas in early project stages.”

In this regard, it is important to keep in mind that products by Evonik do not cause greenhouse gases during the use phase, but that the emissions are generally caused by product applications in which the products by Evonik are just one component. Accordingly, only a proportion of total emissions and reductions can be attributed to the Evonik product. To determine this share, Evonik always considers the total emission balance over the entire product application life cycle instead of just during the use phase of the application. The share of Evonik in reductions is calculated as the proportionate difference between the life cycle emissions of the application with the Evonik product and those of the application without the Evonik product (see Figure 7). If only the Evonik product is necessary to generate CO_2eq savings, 100% of the savings are accredited to this product (“reduction driver”). If the Evonik product is not exclusively essential to CO_2eq savings, reductions are allocated by either a functional or a value-based approach.

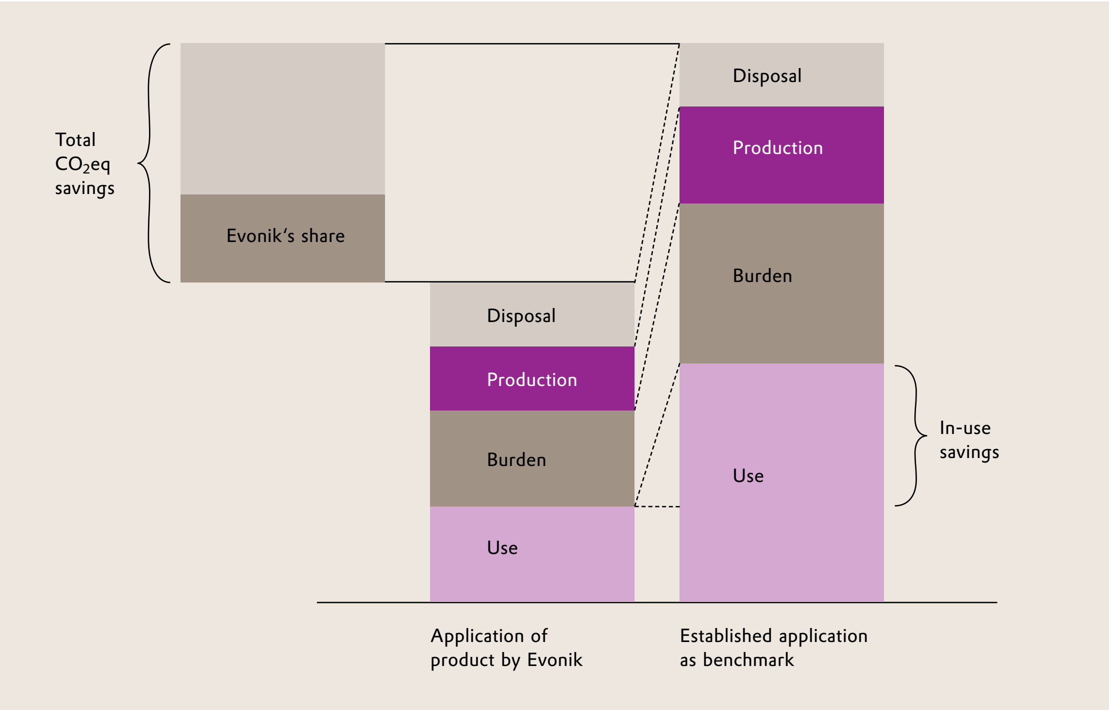


Figure 7: Illustration of CO_2eq emissions, savings and Evonik share

[8] GaBi (Versions 4 and 5) software system and databases for Life Cycle Engineering by PE International, Leinfelden-Echterdingen, Germany and LBP, Chair of Building Physics, University of Stuttgart, Germany, Copyright TM, Stuttgart, Echterdingen 1992–2008

Greenhouse gas reductions are calculated in the following cases:

- Comparison of emissions over the full life cycles of applications with products by Evonik with similar alternatives without the corresponding products by Evonik
  Innovative product applications of Evonik are currently being compared to reference applications established in the marketplace that fulfill a similar purpose. Prorated greenhouse gas emission savings are calculated for the entire sold product volume of this application if it has a lesser market penetration than the reference application. If the Evonik product has a higher market penetration than the reference application, prorated greenhouse gas emissions are calculated only for volume increases over the past year, for example due to new customer accounts. These prerequisites ensure that savings only are calculated for new and innovative products by Evonik with reference to the entire sold product volume, while recording just volume increases for established applications. If there is no substantial alternative, the comparison can also be performed between the application with the product by Evonik and the same application without an alternative product, if the latter is applicable and reasonable.

- Comparison of full life cycle emissions of applications with improved products by Evonik with the status of last year
  Products of Evonik are subject to continuous improvement processes. The greenhouse gas emissions of the resulting applications are compared to the status achieved in the previous year, and the calculated greenhouse gas reductions are included in the balance sheet.

The approach described above to calculate CO_2eq emissions and reductions for Evonik is subject to certain limitations:

- Infrastructure measures such as construction of facilities, machinery, roads, and IT equipment are not included.
- Due to the large number of products by Evonik, the carbon footprint was calculated only for specific beacon applications that were identified in a screening process. Evonik does not claim to have a complete data inventory on the CO_2eq emissions and savings of its full product range.
- Evonik is aware that Evonik product emissions are recorded both in the Evonik Corporate Carbon Footprint and in the savings calculations for applications.
- Evonik is also aware that a CFE cannot replace a full LCA for a precise calculation of emissions and a detailed comparison of CO_2eq reductions.

2.1 Greenhouse gas emission reductions from "green tire" technology

How does the technology reduce greenhouse gas emissions?

Compared to conventional car tires, the use of silica-silane systems–the so-called "green tire" technology–can achieve significant fuel savings and improved wet traction without abrasion losses (see Figure 8). The lower fuel consumption causes end-users to generate fewer CO_2eq emissions.

Background

The rubber compound of a tire has a major impact on the characteristics of the overall tire performance. Organic and inorganic chemicals determine the performance of the tread composition that is in contact with the road surface. Such treads typically contain about 30% reinforcing filler, without which rubber compounds could not reach the desired properties such as traction, abrasion resistance, and resistance to tearing and cuts. For decades, these properties could be achieved only with customized carbon blacks. Today, the replacement of carbon black with silica offers an additional opportunity for further optimization in car tires. Due to the different chemical properties of rubber and silica, however, these components cannot bond to form a single chemical compound. This is where bifunctional organic silicon compounds—or organosilanes—come in. They serve as coupling agents and form a bridge that bonds the two substances.

Key characteristics such as rolling resistance, wet traction, and abrasion resistance can generally not be optimized to a great extent without causing other properties to deteriorate. In contrast to conventional carbon black filler systems, the use of silica-silane systems has allowed for the first change of this "magic triangle" of tire performance (see Figure 9) in a long time. Rolling resistance and wet traction were substantially improved without any negative effect on abrasion, and therefore, the service life of the tire. These improvements have resulted in significantly lower fuel consumption for end-users, and therefore, have led to reduced CO_2eq emissions.

Methodology to determine greenhouse gas emission savings

The internal Life Cycle Management team of Evonik performed a Life Cycle Assessment (LCA) in 2010 in close cooperation with the Inorganic Materials Business Unit to determine savings in greenhouse gas emissions. As part of the LCA, two different tire treads ("green tire" and conventional carbon black tire) were compared over their entire life cycle. Several tire treads were used in a compact vehicle with a capacity of 150,000 km to balance the use phase. For reasons of simplicity, identical emissions (for example those associated with the manufacture and disposal of the remaining vehicle other than the tire treads) were not taken into account. This approach had no impact on the amount of savings. Green tire technology was used with lesser frequency than conventional carbon black tires around the world in 2012. Greenhouse gas emissions were calculated on the basis of emissions in the life cycles of the tire treads (except use phase) and the fuel savings determined for green tires (use phase).

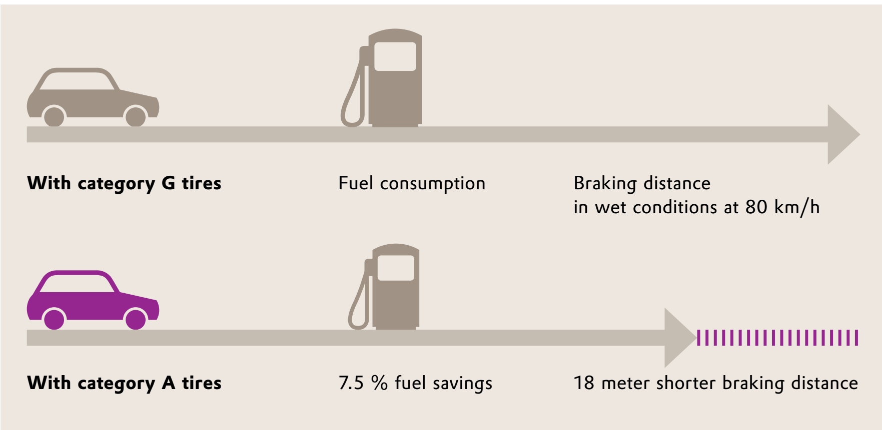


Figure 8: Braking characteristics and fuel consumption
(Categories according to European Tire Labelling Regulation EC/1222/2009)

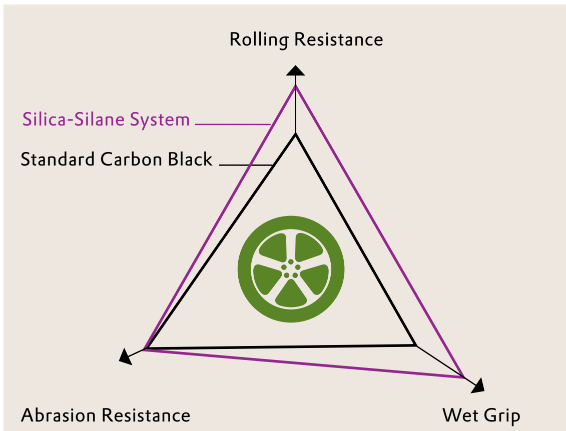


Figure 9: Expansion of the „magic triangle"
with the silica-silane system

2.2 Greenhouse gas emission savings from MetAMINO® in animal feed

How does the technology reduce greenhouse gas emissions?

Animal feed is specifically formulated to meet the physiological nutrition needs of animals, particularly the necessary shares of essential amino acids. Lack of certain amino acids in animal feed can be compensated either by adding a higher percentage of protein-rich feed components such as oil seed, or by fortifying the feed with essential amino acids produced by Evonik for this purpose. Supplementing animal feed with essential amino acids can save significant amounts of feed raw materials, resulting in minimized use of arable land for crop production and thus, fewer CO_2eq emissions. Furthermore, feed supplementation with these essential amino acids reduces both nitrogen and greenhouse gas emissions resulting from feeding.

Background

MetAMINO® is an amino acid containing sulfur. Unlike several other amino acids, it cannot be generated in the animal's own body. Methionine is particularly important in poultry nutrition, as poultry has a much higher demand for this protein-forming amino acid than other species because of feather growth.

Evonik manufactures feed grade MetAMINO® in a chemical process called the "carbonate" process (see Figure 10). The company produces all important intermediates of the process such as acrolein, methyl mercaptan, and hydrocyanic acid in an integrated production at the same site. The required raw materials such as crude oil and natural gas are provided by pipeline. All reaction steps are fully integrated into various cycles with maximum recycling of by-products and waste streams, and by-products and intermediates as well as energy streams can be used by other plants at the same integrated site.

Methodology to determine greenhouse gas emission savings

The calculation to determine greenhouse gas emission savings was based on the greenhouse gases emitted by global DL methionine production and the global emission savings associated with DL methionine. This was based on the study entitled „Innovations for Greenhouse Gas Reductions. A life cycle quantification of carbon abatement solutions enabled by the chemical industry" by the International Council of Chemical Associations (ICCA), which was reviewed by the German Ecology Institute. The greenhouse gas emission savings were calculated on a prorated basis of the Evonik production volume as part of carbon footprint estimation (CFE). It was also reviewed whether the majority of feeds produced all over the world are non-supplemented or supplemented.

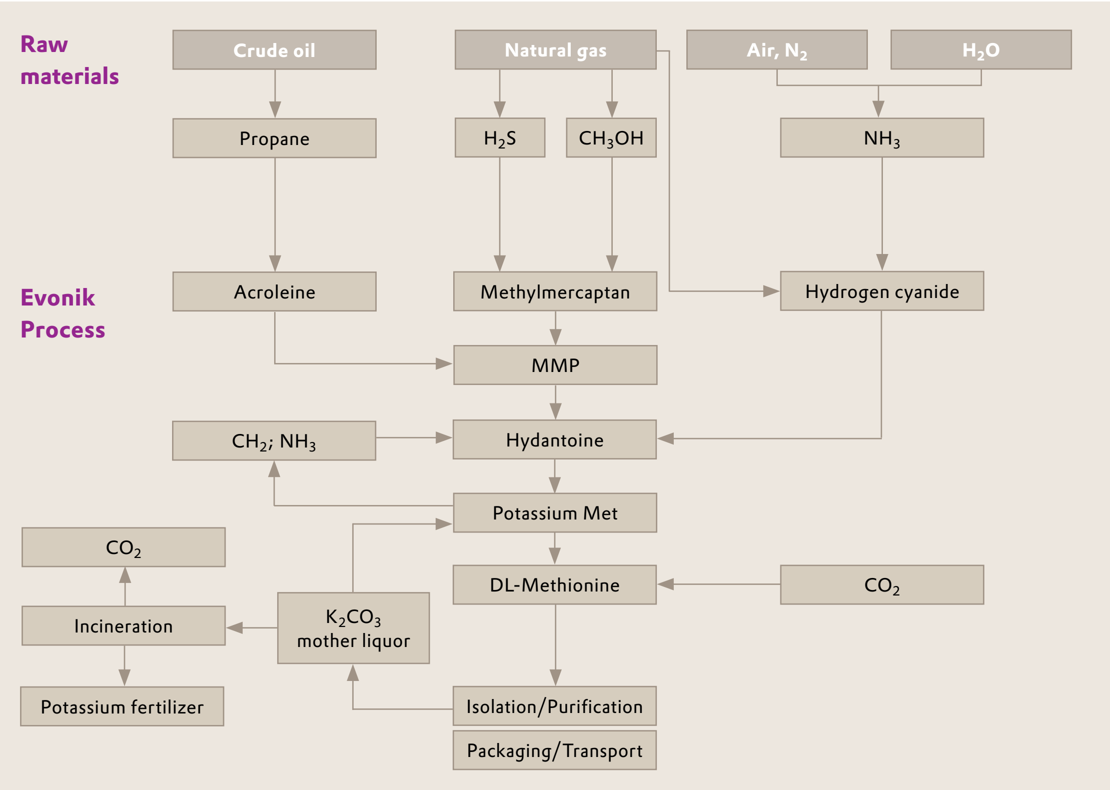


Figure 10: Production of feed grade MetAMINO®

2.3 Greenhouse gas emission savings from optimized insulation materials

How does the technology reduce greenhouse gas emissions?

Evonik develops additives, and particularly foam stabilizers, which are essential to producing and optimizing foam properties. These foams are used, for example, in building insulation or for insulating electrical appliances such as refrigerators. The improvement of insulation properties reduces energy consumption and therefore makes a contribution to reducing greenhouse gas emissions.

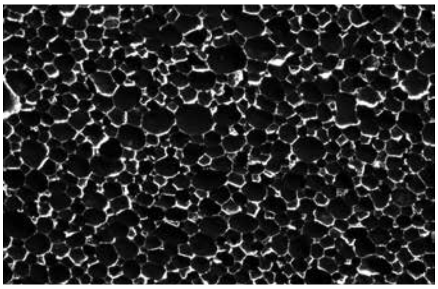
Background

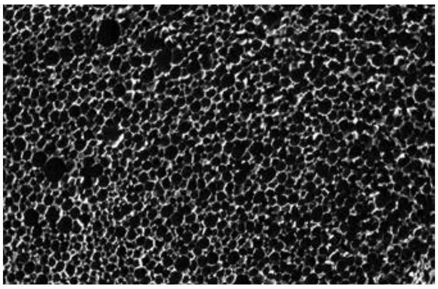
The latest developments in the field of foam stabilizers have produced microfine cell structures that improve the heat-insulating properties of foams.

The structure of foam cells, however, is not the only factor that determines insulation efficiency, and homogeneous distribution of the foam is equally important. Accordingly, improving the flow property of foams is an important objective for additive manufacturers.

Methodology to determine greenhouse gas emission savings

Two application scenarios were studied within the scope of carbon footprint estimation (CFE), namely the use of foam stabilizers in building insulation and in the insulation of refrigerators. Foam stabilizers optimized by Evonik were compared with the effect of insulation materials made with conventional foam stabilizers. In both cases, energy savings were determined on the basis of suitable assumptions and converted into greenhouse gas emission savings.





Microscopic images illustrate the positive effect of optimized Evonik foam stabilizers on the cell structure of rigid polyurethane foams. The top shows a microscopic image of the cell structure of a modern foam system for refrigerator insulation; the bottom image shows foam containing the same polyurethane system, in which the standard additives were exchanged for the new additives by Evonik (same magnification). The smaller the cell size, the lower the transmittance of heat radiation, which results in a lower overall thermal conductivity of the foam.

2.4 Greenhouse gas emission savings from compact fluorescent lamps (CFLs)

How does the technology reduce greenhouse gas emissions?

Modern compact fluorescent lamps (CFLs) with specialty oxides by Evonik consume less electricity during their use phase than conventional CFLs that do not contain these specialty oxides. This reduced energy consumption results in fewer greenhouse gas emissions based on the use of CFLs. Furthermore, compared with CFLs without specialty oxides by Evonik, modern CFLs have almost twice the life expectancy, which can lead to further reductions of CO_2eq emissions.

Background

Specialty Evonik oxides, such as fumed aluminum oxides, perform many functions in CFLs. Their use can significantly improve the performance of these types of lamps (see Figure 11):

- The adhesion of fluorescent materials to one another and to the glass surface is inherently poor because both the fluorescent materials and the glass surface usually have a negative surface charge. Aluminum oxide, which has a positive surface charge, can be used as a stable inorganic bonding agent in this environment. A separating aluminum oxide layer between the glass tube and the layer of fluorescent material not only improves adhesion, but also fulfills other critical functions.

- To maximize the effectiveness of fluorescent lamps, the generated UV light must be fully converted to visible light, as UV radiation that is not converted will be absorbed by the glass tube and converted to heat. To prevent this, the layer of fluorescent materials could be made thicker. While this would keep the UV radiation from being absorbed by the glass, it would also prevent the visible light that is generated from leaving the tube. The use of aluminum oxide as a selective UV reflector offers a much better solution than increasing the thickness of the fluorescent material. In addition to its function as a selective UV reflector that permits light to pass through, it also acts as a barrier for other materials (see below).

- Without fumed aluminum oxide, small amounts of mercury continuously penetrate the layer of fluorescent material and the glass tube. This causes the tube to turn gray over time. This graying affects efficiency as well as light yield: First, less mercury is available, although it is needed to produce UV radiation (less mercury, less light). Secondly, as the tube turns gray, it absorbs more visible light, increasing the transformation of light into heat. Solutions to compensate for these losses include increasing the amount of mercury and the wattage of the lamp. This results in the generation of more heat and promotes the process of diffusion even more. A layer of aluminum oxide acts as an effective mercury barrier. It keeps the use of this toxic heavy metal to a minimum, while simultaneously increasing the service life of the lamp.

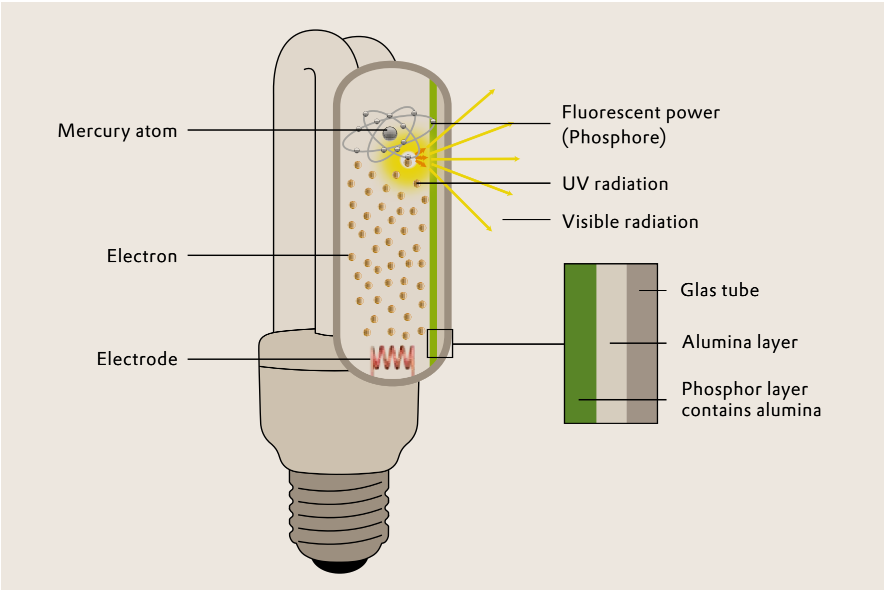


Figure 11: Design of a fluorescent lamp

Methodology to determine greenhouse gas emission savings

The greenhouse gas emission savings associated with the use of specialty oxides in CFLs were determined with carbon footprint estimation (CFE). The internal Life Cycle Management team of Evonik also performed a Life Cycle Assessment (LCA) for the specialty oxide in close cooperation with the Inorganic Materials Business Unit. The comparison involved two 11-W CFL, of which one was equipped with a specialty oxide layer of Evonik. The conventional CFL contained no specialty oxide layer and represents the variety that is used with far greater frequency around the world. A certain light yield was used the functional unit. Based on additional suitable assumptions, both the greenhouse gas emission savings from the reduced energy consumption and longer life expectancy of the CFL with specialty oxide coating were analyzed.

3 Results

Compared to their established alternatives, the analyzed applications of select beacon products save the volumes of greenhouse gas emissions shown in Table 4.

In large part, these reductions are caused by the four products described above, including "green tire" technology, amino acids in animal feed, foam stabilizers for insulation materials, and special oxides in compact fluorescent lamps. The greenhouse gas emission savings were determined with the methodology described above in each case. They are generated over the life cycle of applications that are manufactured with the product volumes sold by Evonik in the specified year.

The decline of greenhouse gas emission savings from 2008 to 2009 is attributable to reduced sales volumes associated with the global economic crisis and to the adjustment of the Evonik share in the calculation of product-related savings based on more recent insights. The increase of reductions from 2009 is mainly due to increases in sales volumes.

Table 4: Development of greenhouse gas emission savings over the life cycle of applications of select products by Evonik that were sold in the specified year

	2008	2009	2010	2011	2012
CO_2eq emissions in million metric tons	43.5	38.3	45.1	47.1	50.1

Independent Assurance Report

To Evonik Industries AG, Essen

PricewaterhouseCoopers AG Wirtschaftsprüfungsgesellschaft has performed a limited assurance engagement on the German version of selected information shown in tables 1 and 3, as well as figure 6 of the accompanying description „Corporate Carbon Footprint 2008-2012 Evonik Industries (Specialty Chemicals as Core Business)" as of July 23th, 2013 and issued an independent assurance report, authoritative in German language, which has been translated by Evonik Industries AG as follows:

We have been engaged to perform a limited assurance engagement on greenhouse gas emissions data selected and presented in the tables 1 and 2 and in the pictures 7, 8 and 9 of the accompanying description „Corporate Carbon Footprint 2008-2012 Evonik Industries (Specialty Chemicals as Core Business)" as of July 23th, 2013 (hereafter "GHG emissions 2012") of Evonik Industries AG, Essen (the „Company").

Management's Responsibility

Company's Management is responsible for the proper presentation of the GHG emissions 2012 in accordance with the criteria set out in the publication „A Corporate Accounting and Reporting Standard – Revised Edition 2004" of the Greenhouse Gas Protocol Initiative (World Business Council for Sustainable Development / World Resources Institute)

- relevance,
- completeness,
- consistency,
- transparency and
- accuracy

(pages 8+9, hereafter „GHG Protocol criteria") under consideration of the supplementary principles included in the accompanying description and for such internal control as management determines is necessary to enable the proper determination of the GHG emissions 2012.

Practitioner's Responsibility

Our responsibility is to express a conclusion based on our work performed as to whether anything has come to our attention that causes us to believe that GHG emissions 2012 marked have not been prepared in accordance with the GHG Protocol criteria under consideration of the supplementary principles included in the accompanying description. The GHG emissions 2012 selected by the Company and evaluated by us have been marked with red check marks.

Moreover, we have been engaged to express recommendations for further developments of the GHG emissions 2012 based on the results of our limited assurance engagement.

We conducted our work in accordance with the International Standard on Assurance Engagements (ISAE) 3000. This Standard requires that we comply with ethical requirements and plan and perform the assurance engagement, under consideration of materiality, to provide our conclusion with limited assurance.

In a limited assurance engagement the evidence-gathering procedures are more limited than for a reasonable assurance engagement, and therefore less assurance is obtained than in a reasonable assurance engagement. The procedures selected depend on the practitioner's judgment.

Within the scope of our engagement we have performed the following procedures:

- Inspecting the documentation of the systems, processes and documents of the GHG emissions 2012.
- Evaluation of the procedures and systems, which represent the basis for the determination of the baseline / reference values regarding the emission saving products and solutions of the GHG emissions 2012.
- Inquiries of the department "Process Technology & Engineering" and "Procurement Strategy" personell responsible for the preparation of the GHG emissions 2012.
- Inquiries of the personnel of selected business units of the division Chemicals involved in performing the calculating of selected emission saving products and solutions.

- Inquiries of external consultants who were in involved in calculating the GHG emissions 2012.
- Understanding the general calculation regarding both the sum of greenhouse gas emissions and emissions saved through using the products and solutions of the product portfolio in the fiscal year 2012.
- Checking the consistent application of the baseline and reference values of selected emission saving products and solutions.
- Checking on a sample basis the activity data against company-internal systems.

Conclusion

Based on our limited assurance engagement nothing has come to our attention that causes us to believe that the marked GHG emissions 2012 have not been prepared in accordance with the GHG Protocol criteria under consideration of the supplementary principles included in the accompanying description.

Emphasis of matter – Use of estimates and assumptions

Without qualifying our conclusion we refer to the fact pointed out by Company's Management in the accompanying description on page 7 that the calculation of the GHG emissions 2012 is by nature partly based on estimates and assumptions.

Emphasis of matter – Recommendations

Without qualifying our conclusion we recommend the following for the further development of the GHG emissions data:

- That the systems, processes and controls, and methodologies for the preparation of the greenhouse gas emissions, which are currently developed on a project basis, be transferred into regular operations
- That the processes for the calculation and documentation as well as the approval procedures for the calculation results in the business units be applied consistently across the whole group
- That a regular review of calculation methodologies, and parameters and baselines be applied, particularly as regards emissions savings
- That processes surrounding „lighthouse" projects be further formalised and that a review board be implemented

General Terms of Engagement

We issue this report on the basis of the engagement agreed with the Company, which comprises the attached General Terms of Engagement for Wirtschaftsprüfer and Wirtschaftsprüfungsgesellschaften as of 1 January 2002, which are also applicable to third parties.

Berlin, 30th July 2013
PricewaterhouseCoopers
Aktiengesellschaft
Wirtschaftsprüfungsgesellschaft

signed Christof Menzies

signed. ppa. Robert Prengel

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