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# The handbook for good eco-publishing

Good practices guidelines for eco-publishing and eco-design in the publishing sector (books and magazines)
LIFE+ 09 ENV/ES/000457 Project

LEITAT Technological Center
el tinter Comunicació
simple efficient solutions

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2012-2013
This guide is the result of LIFE+ Greening Books Project ENV/ES/000457 09 (D.4.9)

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Printed in Catalonia

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# 0. Presentation



Eco-publishing is an innovative form of sustainable publishing. It involves incorporating environmental criteria in the publishing process that minimizes the activity's negative impact during all its phases. Eco-publishing promotes the use of the best techniques available and the best environmental practices during the product's life span: from obtaining the raw material to the end of its useful life. This means having to adopt environmental criteria with a view to the raw materials, design, printing, distribution, use and reuse or recycling.

This handbook offers useful information for those who are in charge of designing, editing and printing artwork but especially for those interested in eco-publishing. On one hand it is a descriptive manual, but on the other it also includes good practices.

Even though the handbook mainly deals with publications (books and magazines) much of the advice can also be applied to graphic arts in general.

Eco-publishing is not a trend or a publicity stunt with the aim of trivializing society's environmental commitment. Its aim is to reduce environmental impact, give tips for more efficient material management and to help achieve excellence by applying the proposals that this handbook outlines – as well as adopting an informative environmental impact label that will allow the publishing industry to improve their efficiency and sustainability.

So as to reduce as much as possible the environmental impact of all publishing, eco-publishing tries to achieve the most efficient use possible of natural resources and avoid generating unnecessary and/or dangerous waste during the production process. We must also highlight that, substituting toxic substances for those that are less toxic has an extremely positive impact on all involved in the process, starting with those first affected: workers in the paper and graphic art industries.

If industrial production were incompatible with the preservation of a habitable biosphere, we would have to give up or drastically reduce output. Even though at present it is not possible to produce something without generating waste, it is possible to produce and minimize environmental impact. Saying

that, we can't rule out that in the future, proposals for innovation and sustainability will achieve this during the whole production and editorial process, by using waste generated as raw materials in making produce for other markets, something along the lines of what architect William Andrews McDonough and chemist Michael Braungart propose in their book "Cradle to Cradle".

Despite the fact that the principle of contamination free production does not exhaust the field of clean production, it does constitute the main element of any sustainability strategy.

Clean production is a process that requires attainable goals and constantly evolving requirements. It is a preventative environmental strategy that is integrated into processes, products and services with the aim of reaching a more efficient use of natural resources and, therefore, minimizing waste, contamination, and hazards to health as well as human and environmental safety.



Greening Books LIFE+ Project, that has taken some three years (2010-2013) to develop, has the aim of reducing the environmental impact from publications: the use of natural resources, contaminants in the air and water, waste, greenhouse gases, chemical substances and compounds. It involves making sure that the management and use of natural resources in the publication sector fully analyse the life cycle of each product, preventing excessive generation of waste, whilst at the same time promoting maximum recovery and recycling, ultimately; placing the emphasis on the life cycle and eco-design of every publication. It goes without saying that this good environmental management will help reduce the carbon footprint of the publishing sector.

The second main aim is to increase awareness regarding the environmental impact of the publishing sector in general and, in particular, each product that is purchased, all with the intention of promoting the habit of purchasing only sustainable publications.

And, finally, the third objective of Greening Books is to increase knowledge amongst publishers and professionals of how to reduce environmental impact in the publishing sector.

To reach the appropriate audiences, a tool has been developed to provide suppliers with information regarding environmental changes and a book's carbon footprint, etc. in order to increase awareness and consequently the active role of those involved.

# 1. Background: How we have reached this point



In the 90's, as reported by Greenpeace, a fourth of all special waste that was produced in Spain came from one industry: paper and cellulose making. These factories were a perfect example of how applying clean technologies could be a solution to the waste crisis.

The hazard of the waste that was being discharged into the water from the cellulose factory came, in great part, from the organochlorinated compounds that it contained. These compounds are toxic, accumulate in living beings and remain in the environment for decades. The combination of these three properties means that, even when diluted two thousand times, they are still toxic for aquatic life.

Environmentalists and those who protect environmental health and joint assets reacted; considering that the presence of such organochlorinated substances in the environment was totally unacceptable, and that the only amount that could be acceptable to dump was zero, and, as this was technically impossible, the process for whitening paper and cellulose had to be changed.

It was possible to substitute bleach by using other whitening agents, like hydrogen peroxide or oxygen. At first paper wasn't so white, but using ivory coloured paper could eliminate 450.000 tons a year of toxic waste from the environment, according to Greenpeace and the Worldwatch Institute.

Twenty years on, we are still waiting to see what has been done and what is the balance of this claimed waste reduction, talking about both the amount and the toxicity: what has really been reduced and what has just been moved to other parts of the planet. A well-developed assessment of dirty industry will allow us to find out the amount of deaths caused, that is to say damage caused to human life and the surroundings.

This example only refers to residues. But, in the words of Barry Commoner (1917-2012), the war of the "technosphere" against the biosphere should also take into account energy use, incorporation of toxic substances into inks and the use of water and plastics for finishes. After analyzing restrictive regula-

tions, this American biologist provides an argument which backs those who, in the light of the results of applying such restrictive regulations, prove that regulation is not the solution; instead substitution and bans are the only way to improve the environment. In his book *At Peace with the Planet* (1990) Commoner sets the basis for industrial ecology as dialogue between social movements and new trade unions.

The contradiction was, and is that, from the first day that paper was made, the vegetable materials used were renewable, recyclable, and were in fact recycled. That is to say, the source of the raw materials, their transformation, use and their final destination, use a natural resource. This brings about the possibility of closing the loop, giving it continuity in different cycles and lives.



## The Eco-Publishing Parliament and the Greening Books Project

The Eco-Publishing group was formed in 2008, it is made up of organizations, companies and experts who decided to get together in order to spread this concept.

In 2008 Foment de les Arts Decoratives de Barcelona, FAD (Barcelona's Decorative Arts Promoter) held a conference about the eco-publishing of a green book. The conclusions drawn at this conference (www.ecoedicio.cat/?p=27) pointed to the need of structuring a joint workspace for the whole book value chain. It came to be called the Eco-publishing Parliament.

Previous to this, roundtables and even an exhibition had been held. On this occasion, more than three hundred people formulated the request to form the Eco-publishing Parliament, a discussion platform that would count on, as mentioned, the participation of agents from all the book publishing value chain.

This was how in 2009 and 2010 plenary sessions were held as well as work groups dedicated to each of the points proposed at the conference.

At the end of 2010, El Tinter, Leitat and Simpple, three organization members of the Eco-publishing Parliament, presented a LIFE+ Project to the EU: Greening Books.

**Leitat** is a technological centre that has as its objective the supply of efficient services to businesses in the industrial sector providing added value both to products and processes. It centres its activity on research, development and innovation (R&D&I) and its services are clearly oriented to helping the business network adapt to the constant changes and demands, as well as providing companies with the most efficient and sustainable solutions.

Since it was founded, in 1906, the **Centre Tecnològic Leitat** has focused its activity on business needs by promoting honesty, professionalism and respect for both people and the environment. Based on this commitment of finding the best technological solutions, **Leitat** collaborates with public entities, government organizations, universities and other technological centres to find the most efficient solutions for its member's problems. In line with this commitment, one of **Leitat's** strategies is to promote R&D&I so as to improve the production process whilst respecting the environment.

Accordingly, the Unidad de Medio Ambiente (Environmental Unit) carries out projects and initiatives that promote innovation and efficient management in all environmental aspects with the aim of preserving and improving environmental quality, as well as contributing to substantial economic savings for the public and private sectors. As well as the R&D activities and projects, their other lines of action are advice and training. Ultimately, **Leitat**, develops its activities in the following fields: industrial ecology through a combination of environmental sustainability, technology and economy; ecologically innovative products and processes that contribute to a sustainable development (eco-design and life cycle assessment LCA), environmental management and management labelling tools, to evaluate, inform and improve environmental performance (EMAS, SGMA ISO 14001:2004, eco-label, etc.); and environmental training.

el tinter
Comunicació

**El Tinter** is a communications company, offering design services, literary production, printing, audiovisual production and multimedia art. It is a leading company in eco-design and ecological publishing, backed by years of experience and certified in outstanding quality and environmental protection. It bases its work on professionalism and the participation of the team that makes up the company, always searching for continual improvement and client satisfaction whether big companies or individuals.



**El Tinter** was the first graphic and audiovisual art company to implement the EMAS (2000). It also introduced the ISO: 14001 (2000), the quality ISO: 9001 (2007), the eco-design UNE150:301 (2008) and the paper custody chain FSC (2009). All these standards prove the company's commitment to carrying out quality work with the least environmental impact. The company has taken part in the forming of the Grup d'Ecoedició de Barcelona GEBCN (Barcelona's Eco-Editing group), which investigates and then shares how to edit any type of publication with the highest respect for the natural surroundings. It has also taken part in forming Cataluña's EMAS club that promotes continual improvement of companies' ecological behaviour and public recognition of said behaviour.

simpple®
efficient solutions

**Simpple** was formed mid-2000 as a centre for technological innovation for the IT network of the Generalitat de Cataluña, made up of various investigation groups from the Rovira I Virgili University (FeT and AGA). It used the initiative and energy of a group of young entrepreneurs with experience in the knowledge, development and technology transfer projects. From 2004 the innovation centre became a technology based company that would continue to help create value in the business network.

**Simpple** strives to be a benchmark company in the field of R&D&I through the development of technologies and cutting edge products, using innovation and lateral thinking. The company has two main pillars: the team and R&D&I. **Simpple's** key to success is to know how to attract and keep a talented, multidisciplined and eager team, with solid technical and investigative experience. The aim is to make the most of the team's synergy and develop products with a high and innovative technological value.

The task handed out by the Eco-publishing Parliament and taken on by these three companies to develop during the LIFE+ project has been structured into various parts. The first, to be carried out by Leitat, was to analyze the life cycle of publications (one book and one magazine) with the help of their partners, but also of other collaborating companies in the fields of raw materials, design and printing. In this way it has been possible to calculate the environmental impact that they have.

After determining the environmental indicators, Simpple has designed a software tool for editors, designers and printers that makes it possible to calculate the environmental impact of any publication (book or magazine). At the same time, El Tinter, has developed the current guide for good environmental practices for the publishing sector, a handbook that gathers together the results of the LCA, recommended good practices and information about the software tool. To get all these environmental proposals to blend together as much as possible, taking into account all those involved in the life cycle of a book, eight workshops have been organized, with four public priorities: management and decision making, material experts, process experts and lastly, end users.



The workshops were split into two phases. During the first phase many small bilateral meetings were held, and during the second, multilateral meetings and events. Following is a list of the activities carried out:

**First phase (2011)**

- Management and decision makers: meetings with civil services; meetings with publishing houses, distributors and writers.
- Material experts: meetings and gatherings with companies that provide paper and ink, with binders and civil services.
- Process experts: meetings with design and communication companies; meetings with schools and design centres. Various conferences regarding printing, eco-publishing and waste.
- End users: meetings with charities and universities; taking part in events on climate and environmental change. Organization of the Rainbow Warrior III eco-publishing event (in December 2011).

**Second phase (2012)**

- Management and decision makers: among the different meetings, the event "Greening Books progress. Eco-publishing, environmental improvement of books and magazines" was held in the European representation venue in Barcelona (June 2012).
- Material experts: apart from the various meetings held with material experts (for example, a meeting with the Forest Stewardship Council, FSC),

a work session was held with public purchasers, paper manufacturers and distributors about green purchasing: criteria and recommendations (March 2012).

- Process experts: as well as the small meetings programmed, a session was held at the 30th Book Fair in Barcelona, directed to small and medium publishing houses, to speak about eco-publishing as a solution for the economic crisis (October 2012). From the meetings held, it is worth highlighting the one held to discuss the connection between eco-publishing and Creative Commons licenses, in the Instituto Nacional de Administración Pública in Pamplona (February 2012).
- End users: in the Eco-concern association, an event was held about the results of eco-publishing, directed to professors, librarians and readers (April 2012).



In the final phase of the project, El Tinter must also carry out trials in the printing of four publications (the handbook, two other books and a magazine) with a dual purpose: use of the software tool designed by Simpple and the use of good environmental practices obtained during the whole project.

## Dissemination of Greening Books

The dissemination of the Greening Books Project is key to discovering the progress made by the improvements in book and magazine publishing.

On the 17th of November 2011, in the Palau Robert in Barcelona, an important Eco-publishing Parliament was held, eighty people were in attendance: professionals, companies, collectives and institutions. It was a space for work and reflection designed to deal in an innovative way with managing publications according to sustainable guidelines, in other words: eco-publishing. The Parliament's debate was based on four central points, with very specific themes, like the life cycle of a book and the Greening Books progress, but also other aspects linked to the publishing world, like the controversies surrounding electronic books or the proposal of prudent printing or printing on request, and even more generic or global themes, like an assessment of eco-publishing during the International Forest Year.

A decidedly European event was the one held in Barcelona with the title "Greening Book's progress. Eco-publishing; the environmental improvements of books and magazines". As explained earlier, on the 1st of June 2012, in the European Commission Representation and European Parliament venue, some sixty representatives of companies and entities that have committed to the eco-publishing of books and magazines using environmental friendly

criteria met together. During the event, the web site application was introduced as well as the eco-label designed by Simpple. Companies in the fields of graphic art, paper shops, publishers, universities, and other entities took part in an extensive debate regarding the importance of raising awareness in each of those taking part in the publication value chain of the need to incorporate sustainable criteria into their activities.

Apart from the events and workshops that were held, it was considered appropriate to promote this task internationally, specifically with a stand at the London Book Fair that took place in Earl's Court in London. On the 16th, 17th and 18th of April 2012, the Greening Book partners travelled to the fair, which received some twenty four thousand visitors, professionals from the world of publishing and which is aimed mainly at the buying and selling of publishing rights. They got in contact with publishing houses, printers and publishing services companies, to explain to them the results of the industry's environmental impact and to inform them of the Greening Books software tool.



To help the Project get known in the Spanish market, on the 3rd, 4th and 5th of October they took part in the 30th edition of Liber, the International Book Fair held in Barcelona. Meetings were held with eleven publishing houses and contacts were made with printers and publishing service companies. Apart from this, as already mentioned, on the 3rd of October a session on eco-publishing was held to generate interest in its sustainability and competitiveness.

With the aim of making known the Greening Books progress, various graphic and audiovisual materials have been prepared: company magazines, newsletters, leaflets, roll-up banners and videos in Catalan, Spanish and English, that have been distributed among those involved in the eco-publishing and publication eco-design movement. The website www.greeningbooks.eu has been kept up to date with any project news.

## More LIFE+ in Spain

The interest generated in clean production in the graphic arts world, has meant that two simultaneous LIFE+ projects awarded to Spanish organizations are in agreement with the Greening Books philosophy. These projects were led by organizations that we had got to know in various seminars, conferences and fairs, which has made easy the constant interchange of information between these organizations as well as the complementarities of the work.

In the case of AIDO, they are the LIFE+ Projects by SustainGraph and BATsGraph. In the case of the Junta de Andalucía, it's the LIFE+ Eco-publishing.

These three projects actively participated in the Eco-publishing work group, in the CONAMA 2012, managing the life cycle of products, as narrators of the Group's summary document. They contributed valuable information developed during the projects related to:

- Eco-publishing's contribution to company savings.
- Efficient information (voluntary or regulated) for consumer and market control (recommendations for an efficient control).

Lastly, at the conference they presented a joint address entitled "Structure and order of the environmental information of printed publications", in which they explained the labels developed and the existing tools to achieve good environmental communication.

# 2. European Legislation



The development of the European Union's legislation has allowed for an active environmental policy to be adopted, fruit of both social demand and of the outspoken scientific community on ecological deterioration.

In the European Economic Community (EEC) treaties from 1957 they did not foresee the area of responsibility within the environment. Contamination as a cross border problem and the different production regulations related to the environment in the different EEC states were an obstacle for trade, which made free circulation of merchandise difficult. After the United Nation's conference on the Human Environment (Stockholm 1972), an EEC summit in Paris requested that the European Commission prepare a programme for action. From this beginning hundreds of directives were adopted as well as other actions that make up the environmental law for water protection, air quality maintenance, chemical product regulation, flora and fauna protection, workers health care, prevention against acoustic contamination and streamlining of waste management.

Together with the environmental law, the EEC developed environmental action plans that set out guidelines and priority objectives. The third action plan regarding the environment (1983) centred its attention on the basic principle of prevention; and the fourth plan (1987-1992) targeted a transition towards this prevention policy. In the fifth plan (1993-2000) prevention was the focus of community action, with the strategy of reaching full integration of environmental demands through active participation of the main environmental agents affected, and the objective was to try and change trends and practices that are damaging to the environment.

It wasn't until the Maastricht Treaty (1992) that is was possible to adopt majority agreements authorized by the council that would achieve a larger participation from the European Parliament. Even so, these agreements remained subject to unanimity in measures related to planning, the use of the ground, energy and ecological taxes.

Climate protection came to be the new focus of community action due to the demands of the Earth Summit in 1992. Reduction and banning of CFCs

due do the deterioration they cause the ozone layer, assessment of the environmental impact, compliance with the Kyoto Protocol, clampdowns associated with innovation, research and efficiency, are some of the achievements gained. Promotion of investments to improve environmental quality through cohesion and structural funds also make up part of this environmental policy, as well as the LIFE financing program.

Since the summer of 1993, products that have passed the corresponding control are awarded with the European Union's environmental endorsement (Eco-label) that since 1995 is also awarded to businesses after a verified environmental management and audit scheme (EMAS).



In October 1993, the European Agency for the Environment in Copenhagen came into existence, as a centre for information and documentation. It's reports allow us to see imbalances and difficulties so that protecting the environment does not go unheeded by the government officials in benefit of the lobbyists who keep away from collective interests and common properties or goods.

The sixth action plan in terms of the environment, (2002-2012) has contributed to environmental law now covering nearly all scopes as can be deduced from the final evaluation. The main goals in the last ten years have been to increase the Naturaleza 2000 network, political action regarding climate change, and the introduction of a general policy regarding chemical substances.

## LIFE and LIFE+ projects

Created by the Single European Act (1986), that marked the beginnings of European environmental policy, the LIFE+ program began in 1992. In the first phase of the programme (LIFE I), the European Commission, through the Directorate-General for the Environment, focused on three topics: "Sustainable development and environmental quality", "Protection of habitat and nature" and "Others: management, education, training and help to developing nations". In total, between 1992 and 1996, 731 projects were financed in all of Europe. Having recognized the success of this first program, the European Commission decided to move it forward and promote three LIFE+: LIFE II (1996-2000), LIFE III (2000-2004) and LIFE IV (2007-2013). From the beginning (1992) until now, LIFE has jointly financed 3.708 projects and has contributed approximately 2.8 billion Euros to protecting the environment.

Spain, one of the most successful states when it comes to receiving LIFE+ funds, has financed, since 1992, 482 projects, with 319.4 million Euros. The

most successful topic in Spain is environmental innovation (264 projects) followed by nature preservation (213 projects).

Furthermore, since the beginning of the program's period (2007-2013), the indicative financial allocation for Spain has increased with the years (more than 27% between 2007 and 2012), and in 2012 will be 27.219.926 Euros. Cataluña is among the autonomous communities to receive the most money. In 2010 all six of the financed projects were led by Catalonian entities (one on "Information and communication" and five on "Environmental policy and ruling").



## Clean and "cleaner" production

Initially, clean production entails substituting dirty technologies, eliminating toxic products and a substantial reduction of waste. Years later, the expression to be used will be "cleaner production", as it is considered that production is incompatible with "no contamination". From this discovery two different approaches were born: Factor 4, and then Factor 10, based on the life cycle. The reach of that cycle can be considered as: "cradle to cradle", "cradle to gate" or "cradle to grave".

*Factor 4* is the title of a book published in 1997 that is full of examples and good practices and which is the predecessor to Factor 10 and Factor 20. This formula written by Amory B.Lovins, L.Hunter Lovins and Ernst Ulrich von Weissäcker became popular thanks to its plasticity:" doubling wealth, halving resource use".

The central themes of this approach are spills, wastewater treatment systems, incineration and toxic compounds. Based on the explanation of the nature of the conflict as a war between the biosphere and the tecnosphere, the biomimic proposal is born: observation and adaptation of production processes with those of the workings of natural systems.

All this takes place in an internationally accelerated trade setting, without any clear environmental rules, and in which the ingredients, active substances, products and services circulate without any international environmental authority, no United Nations Environmental Organization, essential to reach relevant goals.

## The values emerge before "cleaner" production

1. Consume responsibly and consume less
2. Save resources and use renewable energies
3. Make collective decisions
4. Provide free access to information
5. Guarantee protection for all producers
6. Eliminate toxic products from food and fabrics.
7. Environmental management audit systems
8. Eliminate toxic emissions and spills
9. Eliminate industrial toxic and inert waste
10. Stop the production of toxic products
11. Ban trading in toxic technologies, products and waste.
12. Ban recycling of toxic products
13. Ban contamination and end the impunity of those responsible for contaminating activities, forcing them to face their responsibilities, and at the same time promote and protect those who produce without contamination.



The environmental commitments that have been taken on by Spanish and autonomous administrations are clearly fruit of Spain belonging to the EU, and the pressure of social/environmental movements. According to the ecologist movement, in Spain and Cataluña the protective rules for the environment that stem from the community guidelines are nearly always transposed afterwards. That is to say, that the community guidelines are adapted, often after the deadline, to the Spanish and Catalonian laws due to the Union's demands. Rules, on the other hand, are of direct application and do not need transposition, like the REACH rule, that is directly applied in Spain.

CE ruling 1907/2006 came into force on the 1st of June 2007; regarding registration, evaluation, authorization and restriction of chemicals (REACH). The process that intends to reduce production of toxic products and exposure to said products began in 2011 with the publication of the *White book regarding strategy for future policy in respect to chemical substances and mixes.*

The main element of the REACH regulation is to establish an obligatory registration system for those who produce and import chemical substances. REACH does not allow the marketing of any product that has not been registered, therefore any entity that makes and/or imports from outside the EU any lone substances or mixes, in yearly quantities equal to or above a ton must register them. With this aim, a technical sheet will be presented to the ECHA,

European Chemical Agency – with its headquarters in Helsinki- as well as a chemical security report, this second one for substances made and or imported in annual quantities over 10 tons. The chemical security report must document the substance's classification, the dangers entailed and the assessment of whether it is persistent, bio-accumulative and toxic for reproduction (PBT) or very persistent or very bio-accumulative (MPMB).

Apart from the registration process, REACH also deals with the authorization process and the restriction of substances considered highly dangerous. Any substance that was already restricted in the annex XVII of the regulation may not be made, commercialized or used unless it meets with the conditions of this restriction. The authorization process has as its goal to limit the making and importing of substances considered highly hazardous to human and environmental health. The substances subject to annex XIV of the regulation cannot be commercialized or used without previous authorization from the ECHA. In this case, the producers and importers must request ECHA for authorization for each one of its uses.



The aim of the authorization is to guarantee that any damages derived from highly hazardous substances are controlled and to promote the replacement of high risk substances with appropriate alternative substances or technologies. Finally, ECHA is also in charge of the assessment process.

The responsibilities that each company must fulfil are determined by the role they play in the supply chain. Printers, under the REACH regulation, are considered downstream users and article manufacturers, with the consequent responsibilities. They are not forced to register the chemical substances because they do not produce or import them (they only have to register those purchased from outside the EU). But they do have the obligation to control and register the substances and the providers. However, they must ensure with their providers that all the substances they use are pre-registered or registered in accordance with the use they will have. Therefore, when the company receives the corresponding technical security sheet, they must check that using the substance as a downstream user is covered and apply the risk management procedures that are set out on the sheet.

## Environmental management and audit schemes

Environmental management and audit schemes (EMAS) make up a tool that has great potential for improving companies' environmental behaviour. EMAS ensure the fulfilment of current laws; allow for the identifying of significant environmental aspects and anticipate a continual improvement of environmental management. As some of the improvements they provide we can consider the improvement of process efficiency, the optimization and saving of raw materials, and resources like water, energy, etc. They also allow the prevention and control of the generation of emissions, waste and discharges as well as obtaining exemptions and benefits, permits, licenses or grants and public contracts.



Registered EMAS mean procedures and figures are available that allow environmental behaviour to be measured. Information obtained from an environmental management scheme is very important as it helps identify the scale of the impact so as to introduce environmental improvement processes. It also enables the gathering of information that can then be passed on to all the interested parties in the company. In this way the company is on route to being a good eco-publisher that can be recognized with the eco-publishing insignia that allows them to identify products and services that incorporate certain environmental features.

One of the gauges is the existence of different criteria for purchasing, contracting and supplies, subject to environmental and social criteria, among other parameters. Suppliers can be informed of these criteria so they have the time to incorporate them into the process. When these guidelines are in writing, clients and others can be informed.

A good environmental management involves both image and reduction in costs as well as uniting the team with different, but at the same time, joint goals. The effects go further than just reducing the impact on the environment.

Despite being one of the leading European leaders in EMAS in the publishing and graphic fields, Cataluña still has a long way to go, as the EMAS established in the graphic art industry in Cataluña are limited to twenty with the ISO 14001 and five with the EMAS system.

The European Union has decided to reinforce the environmental management and auditing scheme, EMAS, to differentiate it from the ISO 14001 regulation. EMAS implies a public commitment to data. For the scheme to be fully effective, it is necessary that the workers the suppliers and clients all take part.

## EMAS / ISO 14001. Comparative chart

| Concept | ISO 14001 | EMAS |
|---|---|---|
| 1. Nature | Standard. | European regulation 1221/2009. |
| 2. Promoter | Private entity, International Standard Organization. | Public Administration (European Union). |
| 3. Scope | Worldwide. | Worldwide, but non EU organizations must register through the relevant European organisms. |
| 4. Sectors that can comply | All sectors. | All sectors. |
| 5. Business commitment | Commitment of continual system improvement and pollution prevention. | Promotion of continual improvement regarding environmental behaviour by setting up and applying a management system, a systematic, periodic and objective assessment of that system, diffusing information about the environmental behaviour, open dialogue with interested parties, and active involvement and training of staff. |
| 6. Communication and relationships with external interested parties. | The organization must manage communication with external interested parties and respond. | As well as managing the communication of external interested parties and responding, the organization must show that they maintain open dialogue with the public and other interested parties, like local communities, clients, etc. |
| 7. Initial environ-mental assessment | Advisable.<br>(If there is no EMA already) | Obligatory. |
| 8. Auditing | Internal EMA auditing. There is no time frame in which this has to be carried out. | Internal environmental audit. Intervals of no more than three years. |
| 9. Statement | Leaves open to the organization the decision to publish environmental information externally. If they decide to do so, the organization will establish how this is to be done. | Envisages the drafting and external diffusion of an environmental statement, the contents of which are established in EMAS regulations. The statement must be ratified by the environmental verifier certified during the audit. |
| 10. Certification | The audit must be carried out by a certification body. The certificate is awarded by the company itself (private entity). | The audit must be carried out by an EMAS certified verifier. The EMAS register is awarded by the EMAS competent body (public entity). |
| 11. Worker involvement | Discusses competence, training and awareness but makes no mention of worker involvement as the driving force behind the improvement process. | As well as competence, training and awareness, emphasis is placed on the workers as the driving force behind environmental improvement, and therefore the need for their participation. |
| 12. Compliance with environmental legislation | The organization must identify and apply the legal requirements related to their products, services and activities. It must regularly verify their compliance. | More emphasis is placed on compliance with legislation than the ISO 14001. The organization must be able to show legal compliance in terms of the environment. |
| 13. SME | There are no special conditions or requirements for SMEs. | Provides deadlines with specific conditions for small organizations with the aim of speeding up their participation in EMAS. |
| 14. Environmental behaviour | | The organization must be able to show that the management system and auditing procedures deal with the company's real environmental behaviour in both direct and indirect aspects. |

## Environmental management schemes in the paper sector

EMAS fail in the paper industry due to the lack of worker participation: according to a syndicate study, 57% of these do not know their company's environmental policy and more than 60% have not received any information, as can be deduced from the study made by the Instituto Sindical de Trabajo, Ambiente y Salud (ISTAS, Trade Union Institute for Work, Environment and Health).

The study comprises 78 companies in the sector, 11 of which manufacture paper pulp and 67 manufacture paper and card. 67% of the surveyed installations have an EMAS and 33% have it under review. This deficit increases to 84% in the paper pulp factories. A total of 14 companies have EMAS (Eco-management and audit scheme).



The study *Environmental management schemes and workers in the paper industry* (2010) asks the sector for more EMAS, for workers to participate in environmental matters and for the introduction of the company's joint environmental responsibility by creating the position of an environmental representative.

This study was sponsored by the Ministry of Industry's *Observatorio del Sector Industrial del Papel* (The Paper Industry Observatory). This organism was formed in May 2009 and its members are Aspapel (*Asociación Española de Fabricantes de Pasta, Papel y Cartón*, Aspapel), Spanish Association for Pulp, Paper and Card Manufacturers), the FSC-CCOO (*Federación de Servicios a la Ciudadanía de Comisiones Obreras* – Federation of Services for Citizens Trade Union Commissions) the FIA-UGT (*Federación de Industrias Afines de la Unión General de Trabajadores*-Federation for Related Industries of the Workers General Union) the FEDIT (*Federación Española de Entidades de Innovación y Tecnología* – Spanish Federation of Innovation and Technology Entities) as well as the Ministry of Work and Industry itself.

## The Blue Angel

In 1978, Germany established a globally pioneering label system that was and is a leader in this respect. The German Environment Federal  Agency and the German Institute of labeling are that the bodies that regulate the use of the certificate Blue Angel for paper. The certification can be used by compliance of RAL UZ. These involve four types of paper:

| | | |
|---|---|---|
|  | The Blue Angel emblem is based on the symbol of the United Nations Environment Program (UNEP). The top section reads *Umweltzeichen* (environmental label) and the bottom *Well aus 100% Altpapier* (100% recycled paper) | |
| **Recycled paper** | RAL UZ- 14 regulation, June 1997 | The raw material must be 100% recycled paper fibre despite the 5% tolerance of new fibres.  It is paper that excludes optical whitening and bleaching agents, obtained though a Chlorine free process (PCF). |
| **Recycled cardboard** | RAL UZ-56, June 1997 | The raw material must be 100% recycled paper fibre despite the 5% tolerance of new fibres. It is paper that excludes optical whitening and bleaching agents, obtained though a Chlorine free process (PCF). |
| **Sanitary paper made with recycled fibres** | RAL UZ-5 regulation, June 1997 | The raw material must be 100% recycled paper fibre despite the 5% tolerance of new fibres.  It is paper that excludes optical whitening and bleaching agents, obtained though a Chlorine free process (PCF). |
| **Building materials with recycled cellulose fibres** | RAL Uz-36 January 1999 | The raw materials must be paper fibre with at least 80% recycled fibre and a minimum part of this paper must be low and medium grade recovered paper. |

## Environmental certificates

Even though the term "label" refers to all the information that can be found on a product, the European Eco-label refers to an emblem (picture, logo) that identifies a set of environmental standards and rules of use.

Because of this, environmental standards have been organized into three categories by the International Organization for Standardization (ISO).

- **Type I emblems, in conformity with the DIN EN ISO 14024 regulation**, are awarded to recognized organizations with public access and verified and certified by independent third parties, and are the most relevant. They evaluate the life cycle of environmental aspects. Emblems from the European Union and its member states are type I. Some examples: Etiqueta Ecológica Europea (Europe), Distintiu de Garantia de Qualitat Ambiental (Catalunya), AENOR Medio Ambiente (Spain), Nordic Swan (Denmark, Finland, Norway and Sweden), Blauer Engel (Germany), Milieukeur (Holland) NF Environment (France), mweltzeichen (Austria), Ekosnacka (Cheq Republic), Hungarian Ecolabel (Hungary), Slovak Ecolabel (Eslovaquia) and Polish Ecolabel (Poland).
- **Type II emblems in conformity with ISO 14021 regulation**, highlight a unique environmental aspect of the product, like a reduction in the use of water during its use, or the amount of recycled materials it contains. The ISO rule regulates the basis for calculations and the most common environmental statements.
- **Type III emblems, product environmental statements, in conformity with ISO 14025**, include detailed environmental information on the product, but do not evaluate the degree of environmental improvement (only if being compared with an environmental statement of an equivalent product). They are based on the analysis of the product's life cycle, and, even though verification is obligatory, certification is voluntary and carried out by independent third parties.

  The EPD, environmental product declaration, gathers all the environmental details of a product with a pre-established parameter category according to ISO 14040, for analyzing the life cycle, without excluding other environmental parameters.



### Environmental Product Declarations

In the paper industry there are different schemes for voluntary programs to provide quantified environmental information destined to keep companies informed, but that can also be used to communicate with the end user.

- **Paper profile:** The paper profile is an international, voluntary, program in the industry of pulp and paper, distributors and other associations within the sector which collects environmental information on the product (composition, environmental parameters, environmental management systems, and purchase of wood). www.paperprofile.com
- **Paper Score Card:** A tool developed by the WWF to calculate the ecological footprint of paper products. Manufacturers carry out their own assessment to achieve a score that is then verified by a credited certifying organization. www.panda.org
- **Climate Declaration (EPD):** The information that a product's EPD offers is often considered to be unspecific and too broad because it covers all aspects of the products environmental behaviour.



In most cases, the information gathered in the EPD addresses the users different needs, like ensuring the absence of dangerous chemical products, providing information about the use of renewable or non renewable resources, providing a detailed account of the potential environmental impact within a chosen impact category, or to advise on more appropriate ways to recycle the product or reuse it in the final stage of its useful life.

One area where the demand for information is constantly growing is related to climate change. The international EPD system provides a climate declaration that allows the carbon footprint of products to be calculated and expressed in tons of equivalent carbon dioxide ($CO_2$ eq.). The life cycle of paper products spans from the carbon dioxide released in the forests or plantations to the emissions associated with obtaining the raw materials, the manufacturing of the product as well as its transport, consumption and end of life management. Carbon footprints can only be compared with products of an identical type of manufacture, and using the same calculation methodology in accordance with ISO 14025, and responding to preparation guidelines like the GHG protocol and the ISO 14067 that is still in development. www.environdec.com

The CEPI, Confederation of European Paper Industries, has a guideline with ten basic principles that need to be taken into account when analyzing the life cycle of paper products and when it comes to elaborating the carbon footprint. Along the same lines, there are different voluntary agreement systems to calculate, reduce and compensate for the greenhouse effect gas emitted from different organizations.

### Types of ecological emblems

| ISO 14020.Ecological labels and environmental statements. General principles | Type I labelling |
|---|---|
| ISO Regulation | ISO 14024 |
| Meaning | Products bearing it fulfil certain predetermined environmental requirements, agreed upon by recognised entities, these are of public access. |
| Identifies "ecological" products. | Yes |
| Covers the whole life cycle | Yes |
| Verification/Certification | • Mandatory verification by an independent third party.<br>• Certification by an independent third party. |
| Credibility | High |
| Must meet certain requirements/ environmental criteria | Yes |
| Amount of environmental information shown | Little |
| Cost | Medium/High |
| Recognition | Client (B2B), High<br>Consumer (B2C), low<br>The aim is to award the best products in its class. |

Source: *Etiquetado ambiental de producto. Guía de criterios ambientales para la mejora de producto.* IHOBE. 2011.
*Guía pràctica para la compra de papel*. Aspapel i Fedip. Madrid, 2011.

| **Type II labels. Self environmental statements** | **Type III labels Environmental Product Declaration** | **SEMI labels type I** |
|---|---|---|
| ISO 14021 | ISO 14025<br>UNE 150.025:2003-ISO14025 | None |
| The manufacturer makes their own environmental labels with pictographs, defining their environmental criteria. | A technical report that summarizes the most significant features of the environmental behaviour of a product. | Products bearing it fulfil certain predetermined environmental requirements, agreed upon by recognised entities, these are of public access. |
| Yes, but with less scope than type I | No | Yes |
| No | Yes | No |
| • Mandatory verification by independent third party.<br>• Own certification | • Mandatory verification by independent third party.<br>• Voluntary certification by independent third party | • Mandatory verification by independent third party.<br>• Voluntary certification by independent third party |
| Medium | High | High |
| Voluntary, general and/or specific | No | Yes |
| Variable | A lot | Little |
| Medium | High | Medium/High |
| Client (B2B), medium<br>Consumer (B2C), high<br>It can come to be the image of the brand. | Client (B2B), medium<br>Consumer (B2C), high<br>Technical information that does not reach the product's final user | Client (B2B), medium<br>Consumer (B2C), high<br>The aim is to reach the highest number of products possible |

## The paper Eco-label

The Eco-label is an emblem of the European Union, created in 1992, that guarantees a high level of environmental protection. The emblem evaluates a product or service's environmental advantages throughout its life cycle: the use of raw materials, the production, distribution, usage and waste. For more information go to: www.reciclapapel.org/htm/articles/docs/papel-copias.pdf.



The criteria are standardized and valid for all member states of the European Union. There are twenty-six product categories. They are managed by the European Union Committee for the Eco-label with the support of the European Commission. One of the categories is for copying paper and graphic paper, the other for printed-paper.

Graphic paper marked with an Eco-label on the sheets and rolls of white paper that are used for printing and photocopying, includes writing and drawing, (expect newsprint, thermal paper and carbonless copy paper) must meet the following criteria:

### Raw Materials

Reduction of environmental damage related to the use of natural resources, promoting sustainable management of the forests. Virgin fibres must come from forests that are managed sustainably (more than 10% must come from woods that are certified to be managed sustainably).

The origin of the fibres must be specified.

### Manufacturing

***A. Energy savings***

Use of electricity and fuel expressed by point system: PE ≤ 1.5; PF < 1.5

***B. Reduction of air and water contamination***

Absorbable organic halogens (AOX) < 0.25 kg/t)

Carbon Dioxide ($CO_2$). Emissions from non-renewable energy sources ≤ 1.000 kg/t of paper (1100 kg in non integrated factories).

DCO, S, $NO_x$. Discharges expressed by point system: PCOD, PS, Pox ≤ 1.5 each. PCOD + PS + $PNO_x$ ≤ 3.

***C. Limits on the use of substances hazardous to the environment***

1. Ban chlorine gas as a whitening agent (elementary chlorine). The paper isn't totally free from chlorine (TCF) or made with a free chlorine process (PCF).
2. Chemical substances classified as cancegenic, mutagenic, teratogenic, toxic for reproduction, very toxic for aquatic organisms, or those that can cause damaging effects to aquatic life according to directive 67/548/CEE: limited to 100 ppm, (residual monomers) and 1.000 ppm (acrylamide).
3. Ban alkylphenol ethoxylates (APEO) and other alkylphenol derivatives (APD).
4. Ban azocolourants that can break down into certain aromatic amines.
5. Surfactant solutions used to extract ink from recycled fibres: quickly biodegradable when they add up to ≥ 100 g/ADT (air-dry tonne).
6. Use of biocides or biostatic products that are potentially bioaccumalative is not permitted.
7. The use of colorants that contain more than 2% of elements classified as toxic for aquatic organisms or that can damage aquatic life is limited.
8. Lead, copper, chromium, niquel and aluminium based colours and pigments are banned. Those made from phtalocyanine are allowed.
9. Ionic impurities in colours, in parts per million
   - Ag, silver < 100 ppm
   - As, arsenic < 50 ppm
   - Ba, barium < 100 ppm
   - Cd, cadmium < 20 ppm
   - Co, cobalt < 500 ppm
   - Cr, chromium < 100 ppm
   - Cu, copper < 250 ppm
   - Fe, iron < 2.500 ppm
   - Hg, mercury < 4 ppm
   - Mn, manganese < 1.000 ppm
   - Ni, nickel < 200 ppm
   - Pb, lead < 100 ppm
   - Se, selenium < 20 ppm

Sb, antimony < 50 ppm
Sn, tin < 250 ppm
Zn, zinc < 1.500 ppm

***D. Reduction of the impact of solid waste***

Implementation of a solid waste management system that includes procedures to:

- separate and use recyclable materials
- recover materials for other uses
- treat dangerous waste



***E. Environmental information for the user***

The product's packaging must include information about the environmental benefits of the Eco-label and about the appropriate behaviour to protect the environment.

## Eco-Label for printed-paper and newsprint

Twenty years after the Eco-label was created, the European Union's emblem has reached printed-paper and news print, overcoming all obstacles and resistance from the forestry and paper industry. That is to say, since the Official Journal of the European Union was published on the 21st of August 2012, only products that fulfil the conditions laid out in the decision of the 12th of July 2012 – that establishes the ecological criteria to award the European's ecological label – will be granted the emblem.

These criteria are intended for printed paper products (including the printing and finishes): books, magazines, newspapers, propaganda, leaflets, catalogues, posters, sheets, cards, files, folders, tickets, etc.

The aim is to regulate and promote environmental efficiency through recyclability, reduction of emissions and risks from printers and so called printing services, both commercial and those associated with entities, and external and internal services.

All printing services and subcontractors that want to obtain the Eco-label emblem must fulfil the established criteria. The applicant must present a list of the chemical products used in the printing, and their security file. The requirements include printing inks, toners, overprinting varnish, adhesive, detergents and dissolvent. As well as the identification, they must include the quantities, the suppliers and the security detail sheets, in agreement with directive 2001/58/CE.

**Substrate:** The substrate, that is to say, the paper and news press must meet the requirements of paper certified by the paper's Eco-label. The applicant must provide specifications, like their trading name, amounts as well as the weight of the paper used. That is to say, the printer or publisher must possess a copy of a valid Eco-label certificate for paper to be used for printing.

**Excluded substances:** All excluded or limited products are listed. Inks cannot contain heavy metals, and a statement must be presented with the contents of the aromatic hydrocarbon solvent.



**Emissions:** Inspections for emissions both into air and into water that are associated with the printing process must be listed.

**Waste:** The printed product must be recyclable and the ink removable. It must include the inspection of the waste treatment system and limit them quantitatively in certain processes.

**Energy use:** Includes a record of all devices that use energy (machinery, lighting, air-conditioning, refrigeration, etc) and an energy efficiency program.

**Training:** All those involved must know the requirements of an ecological eco-label thanks to a yearly training plan.

We must point out that the validity of the criteria when applied to the category of printed paper products, as well as the corresponding requirements for assessment and verification, is for three years, starting on the 16th of August 2012. Without a doubt, what will end up determining its generalized use (presently voluntary) will be when it is included in public purchasing and contracting as well as the social demand for these excellent requirements.

This European Union ecological label for printed paper on the one hand will be the way forward for obtaining an eco-publishing label – specifically for books and periodical publications – and on the other hand will mean that eco-published products will include information about their ecological backpack and the good environmental practices of the companies involved in the publishing process.

### The Eco-label's environmental messages

The securing of the Eco-label allows for appeals to obtain the ecological label for printed paper and news press, as well as the one for paper of copies and

graphic paper. The ensuing decisions set out what information can appear on the product by the European Flower: *"Collect used paper so it can be recycled".*

In the information that must appear on printed-paper, in a text box placed next to the optional label can be one of the following three sentences:

- *Recyclable printed product.*
- *Printed on paper of low environmental impact*
- *Limited emissions from chemicals into the atmosphere and water during the paper manufacturing and printing processes.*



In the ecological label for news press, as well as paper for copying and graphic paper, among the label's optional information, one of the following three sentences may appear in a text box:

- *Low water and atmospheric contamination*
- *Use of certified fibres and/or use of recovered fibres (depending on the case)*
- *Limited use of hazardous substances*

In the ecological label for paper for copying and graphic paper, the message "*Recycle Used Paper*" may appear optionally on the product's packaging.

We must once again point out that a label must be made up of a collection of stipulated written information accompanied with pictorial emblems. And that the statements must inform of facts, not amounts or quantities.

## Green purchasing and contracting

The volume of public purchasing and contracting, that represents about 16% of the GDP allows us to see the demand pull for development in the marketing of products and services that are more environmentally responsible.

Ethical and green purchasing and contracting is the purchasing of goods and services that do not take into account just monetary and technical criteria, but also environmental, social and economic, that is to say excellence. In this way one can purchase services and goods that are respectful of the environment, with social rights, fair trade or specifically with explicit and audited commitments: those that offer the levels of quality and service demanded and that at the same time, generate a lesser environmental impact and higher social impart.



The European definition for green public purchasing and contracting (GPPC), included in the European Commission Communication called: "Public Procurement For a Better Environment" is "a process by which public and semi-public authorities decide to purchase products, services, works and contracts in specialist sectors with a reduced environmental impact during their life cycle compared to the products, services works and contracts in the specialist sectors with the same basic use that would have been purchased otherwise."

In Europe, the start of public green purchasing and contracting goes back to the eighties, when they started to be applied in countries like Germany, Austria, Sweden, or Denmark. From the beginning and as time has gone by, the European Commission has carried out studies that recognize the importance of green public purchasing and contracting as the ideal tool to promote and implement the European Union's environmental strategies and policies.

The result has not been very equal, as it oscillates between 80% in Sweden (where green public contracting represents 20% of the GPD) or 70% in the United Kingdom and Germany (countries where the GPPC represents 17% of the GPD) and under 30% in Spain (country that as we can see is lagging behind the big ones when it comes to bids with an environmental criteria). We must highlight the great percentage found in Holland where green public purchasing and contracting represents 100% in the case of the central Government and 50% in other administrations according to data from 2010.

# 3. Analysis of the life cycle of a book and a magazine



The Greening Books Project, that has the aim of improving the environmental behaviour in the publishing sector so as to minimize the impact books and magazines have on the environment, has developed the life cycle assessment (LCA) of a book and a magazine so as to obtain the necessary data to support the arguments both of good practices and of the software tool used to calculate the eco-publishing label.

Presently, the life cycle assessment is not the only methodology in this field, but it is the one that can contribute most to advance the book value chain towards excellence.

The life cycle assessment allows for an exhaustive study of the environmental effects of the chosen product, in this case a book and a magazine. The LCA applied is based on the collection and study of the systems entrances and exits, so as to obtain results that show the potential environmental impacts.

It involves then, a type of metabolic study that includes the entrances that feed the process with the use of resources and raw materials, parts and products, transport, energy, etc and the exits like emissions into the air, water and ground as well as waste generated and by-products.

An important part of the environmental impact of the products studied in this LCA corresponds to what is generated by the extraction and manufacture of the needed raw materials both for a book and a magazine. These impacts are mainly due to the manufacturing process of paper, the most abundant material in proportion to its weight.

The methodology of the life cycle assessment is based on ISO 14040 and ISO 14044 regulations and the recommendations of the International Reference Life Cycle Data System Handbook from the European Platform of Life Cycle Assessment. The phases of a life cycle analysis are the following:

**Definition of objectives and scope:** Identification of the objectives and applications that are derived from them. An LCA can have a large scope. Therefore it is vital to identify where the limits are. The system that is the object of the study must be analyzed, as well as the roles, functional units and system limits.

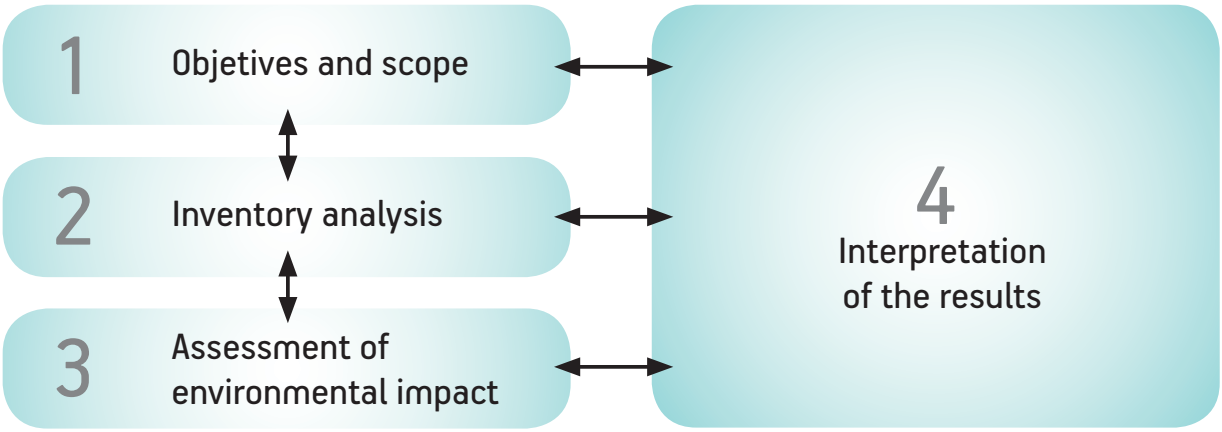
**Inventory analysis:** Collection and measurement of entrances and exits of a system (energy, raw materials, air, water, earth, etc) during its life cycle.

**Assessment of the impact:** know and assess the magnitude and significance of the potential environmental impact of a system during the length of the product's whole life cycle.



**Interpretation of the results:** Conclusions of the inventory analysis of the impact assessment or both. They are assessed in connection with the defined objectives and scope so as to arrive at certain conclusions or recommendations.

**PHASES OF THE LIFE CYCLE ASSESSMENT**




In this case, the software program used is the SimaPro, from the Dutch company PRé Consultants, it is one of the most used, as it is a powerful tool to analyze and simulate the environmental behaviour or products and services. SimaPro uses databases from inventories created by users and accepted data bases like Ecoinvent, BUWAL, IDEMAR, ETH or IVAM. The one used in the study is Ecoinvent 2.2.

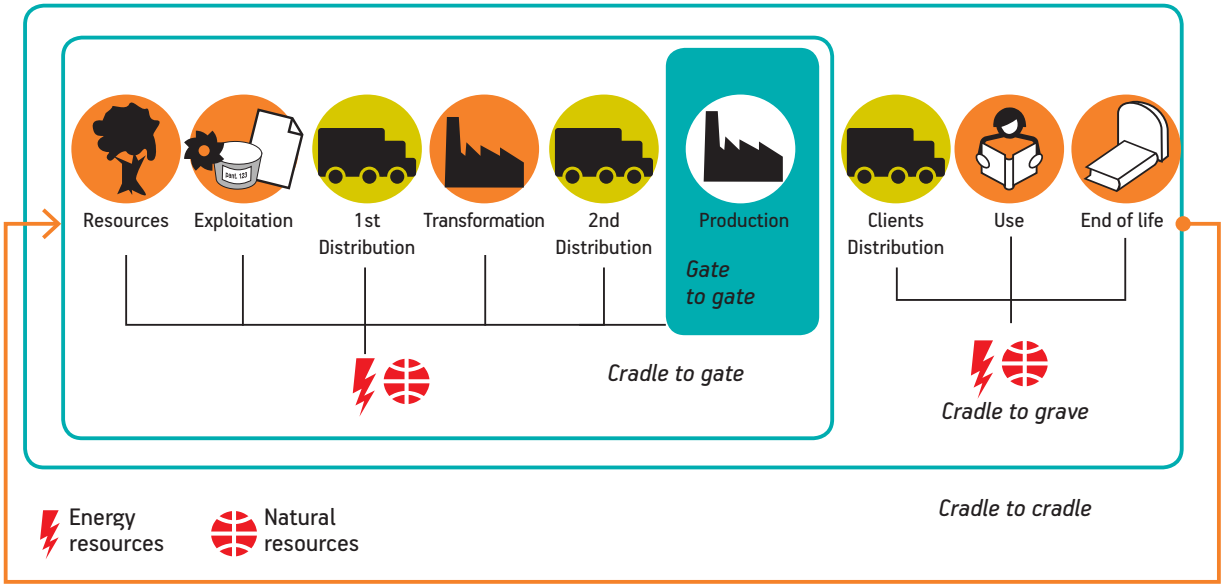
## Objective of a book and magazine LCA

The objective of a LCA is to identify the environmental impact of a standard magazine and book printed in Spain. The study provides plenty of information regarding the environmental impacts produced in the studied areas, identifying which are the more problematic points of the process from an environmental viewpoint.

We should clarify that the objective of the LCA carried out is to evaluate the standard process for printing a book and a magazine, and not that of a specific product or manufacturing process. For this reason the most used technologies and standard processes are the ones studied. This fact has made it difficult to obtain representative data. In some cases, the information has been provided by specific producers or suppliers, for specific points of the printing process. Companies, manufacturers and suppliers from the publishing field have all cooperated by providing data



**TERMINOLOGY RELATED TO THE REACH OF A LCA**




### The study's reach

The reach of the LCA, both for the book and the magazine, encompasses the whole process, from the cradle to the grave, that is to say, all the levels of the life cycle of a product, from the extraction and transformation of the raw materials that make it, to the end of its useful life.

To enable the identification of the key factors within the printing process, different variations have been considered in the analysis, like the use of different types of paper and ink.

The studied system includes all the steps for producing a book and magazine: creation, design, printing and publishing. The system is based on offset printing.

### Functional Units

A functional unit measures the function of the studied system and is the reference point that all entrances, exits and results are directed to. The clear cut functional units for the book and magazine are the following:

A book that has had a circulation of a thousand copies, that contains information that can be read during a period of thirty years, that is a paperback (with paper or card cover), that has ninety six pages measuring 15 x 21 cm and two thirds of it has been printed with one ink and the rest in full colour.



A magazine with a circulation of two thousand copies that contains information to be read within three months that has twenty-eight pages measuring 21 x 29.7 cm and that has been printed in full colour.

### The system and its limits

The system studied is the production process of a book or a magazine, divided into the following subsystems:

- *Production of materials:* The analysis of the paper and the ink has included the corresponding extraction of raw materials and the subsequent production process.
- *Production of the product (book/magazine):* This stage has been divided into creation and design, plate engraving, cleaning and finishing processes.
- *Distribution:* from the Publisher to the shop
- *Use:* No environmental loads have been considered for this stage.
- *Treatment as waste*

## Environmental impacts considered and indicators

The life cycle assessment carried out calculated a product or processes' environmental impact in connection with its influence on the seven categories of impact considered to be most relevant by the ILCD Handbook. For the global warming category, they have used the IPCC 2007 100 years indicator. And for the others; indicators from the Institute of Environmental Science of Leidan University.[1]

1. The ILCD handbook is the International Reference Life Cycle Data System Handbook by the European Life Cycle Assessment platform. The OPCC 2007 100 years, developed by the Intergovernmental Panel of Climate Change, contains the IPCC climate change factors for a period of one hundred years. And the CML 2001 method comes from the Institute of Environmental Science of Leiden University.

**1. GWP, Global Warming Potential**
It considers the increase in the earth's average temperature due to the greenhouse effect caused by the increase in the concentration of greenhouse gases during a century. It is measured in kilos of equivalent carbon dioxide (kg $CO_2$ eq.)

**2. ODP, Ozone Layer Depletion Potential**
Consequence of the presence of halogenated compounds (especially chlorine) in the highest levels of the atmosphere. The main source of this effect is the CFC gases which are very stable and contain chlorine and fluoride, as well as halons which cause the destruction of ozone molecules. It is measured in kg of 11 equivalent chlorofluorocarbons (kg CFC-11 eq.).



**3. AP, Acidification Potential**
Decrease in the environment's pH as a consequence of emissions of acid substances (made up of sulphur, nitrogen, hydrochloric acid, etc.). It considers the impact on the earth and the water environment. It is measured in kilos of equivalent sulphur dioxide (kg $SO_2$ eq.).

**4. Photochemical Oxidants Creation Potential (POCP)**
Compounds created by photochemical in the troposphere, among them ozone (not to be confused with the good ozone that exits in the ozone layer, in the stratosphere, and that blocks the direct impact of the short wave ultraviolet rays that reach the earth's surface from the sun, that otherwise could cause serious harm to all types of life). They are considered negative due to their reactive nature, as they oxidize organic molecules. Inhalation of these gases has a damaging effect on human health, as it provokes irritation and creates respiratory illnesses. With plants, it can attack them on the surface, or get inside them through the leaves' stomas and upset their photosynthesis. It is measured in kilos of equivalent ethylene (kg $C_2H_4$ eq.).

**5. EP, Eutrophication Potential**
Excessive concentration of nutrients (especially nitrates and phosphate derivatives) in the aquatic environment that aids the quick growth of algae; more than the environment can deal with. It causes a lack of light on the waterbed and a depletion of nutrients that are essential to water. The decomposition of the algae causes an important decrease of dissolved oxygen that in turn causes an increase of anoxic reactions that can lead to compounds that are toxic to many species. And this anoxia or strong reduction

of oxygen can also directly affect many organisms by asphyxiation. It is measured in kilos of equivalent phosphate (kg $PO_4^{3-}$ eq.).

**6. HTP, Human Toxicity Potential**
Impact of toxic substances on human beings. It does not include the effects from occupational exposure. It is measured in kilos of equivalent 1, 4-dichlorobenzene (kg 1, 4-DB eq.).

**7. ADP, Abiotic Depletion Potential**
Use of non-renewable or abiotic resources, that is to say, the minerals that are used in the whole system being studied. It is measured in kilos of equivalent antimony mineral (kg Sb eq.).



**Features of the impacts and unit measures**

| Impact category | Units |
|---|---|
| 1. GWP, Global Warming Potential | kg $CO_2$ eq. |
| 2. ODP, Ozone Layer Depletion Potential | kg CFC-11 eq. |
| 3. AP, Acidification Potential | kg $SO_2$ eq. |
| 4. POCP, Photochemical Oxidants Creation Potential | kg $C_2H_4$ eq. |
| 5. EP, Eutrophication Potential | kg $PO_4^{3-}$ eq. |
| 6. HTP, Human Toxicity Potential | kg 1,4-DB eq. |
| 7. ADP, Abiotic Depletion Potential | kg Sb eq. |

In the LCA of this study, the following indicators have also been taken into account:

**1. CEM, Cumulative Energy Demand**
The amount of renewable and non-renewable energy resources that the system requires over its whole cycle. The non-renewable resources are coal, gas, petrol and uranium. In practical terms, it refers to all primary energy contained in the material. It is measured in equivalent mega joules (MJ eq.).



**2. Water use**
Assessment of the water needed by the system being analysed. It is measured in cubic meters ($m^3$). One cubic meter equals 1000 litres (L).

## Results

### Descriptions of general environmental impact

The study has allowed for the assessment of the environmental impact at the different stages within the life cycle of a book and magazine and also to identify the critical points: those that have the most impact. Both for the book and magazine, the general analysis has been carried out taking into account raw materials like recycled paper and inks made with vegetable oils. To try and reduce the environmental impact, changes that could be made in the choice of paper (recycled or non-recycled paper) or the different types of ink (with mineral or vegetable oils) have also been studied.

The general profile of the book analysis points out that the most important part when it comes to the total environmental impact of the product (which varies between 55 and 19% of the total value of impact in the different categories studied: global warming, eutrophication, etc.) is during the extraction and manufacture of the raw materials (paper and ink). This impact is mainly due to the choice of paper that makes up the most abundant material in weight percentage. The same happens with the magazine, in which the main environmental impact is generated in the extraction and manufacture of the raw materials (and varies between 70 and 26% of the total value in the different impact categories studied).

The manufacturing stages of the printing presses and the product distribution also have an important environmental load in all categories of environmental impact.

The design stage also has considerable environmental impact in all impact categories, due to the use of energy, but with values lower than the stages previously mentioned and that present more environmental problems (raw mate-

rials, manufacturing of presses, distribution, etc.). We should highlight, however, the great importance this stage has regarding the impact that can be caused by the others, as it is at the time of designing a book or magazine when the most important decisions are made, like the choice of raw materials, among others.

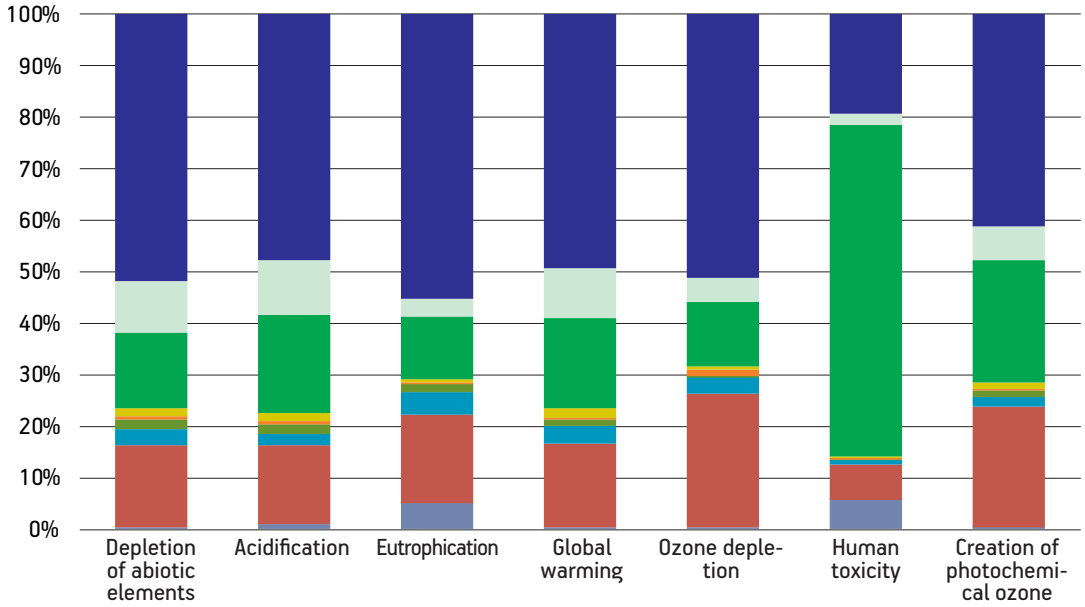
On the other hand, it has been observed that the printing (including the cleaning processes), finishing, plate setting, and waste treatments stages have a low contribution to the global environmental impact of the products.

The use stage of a book or magazine has no environmental load, as it has been considered that during this stage, in which the use of the product is for reading, no materials or energy are used, neither are there any emissions or waste.



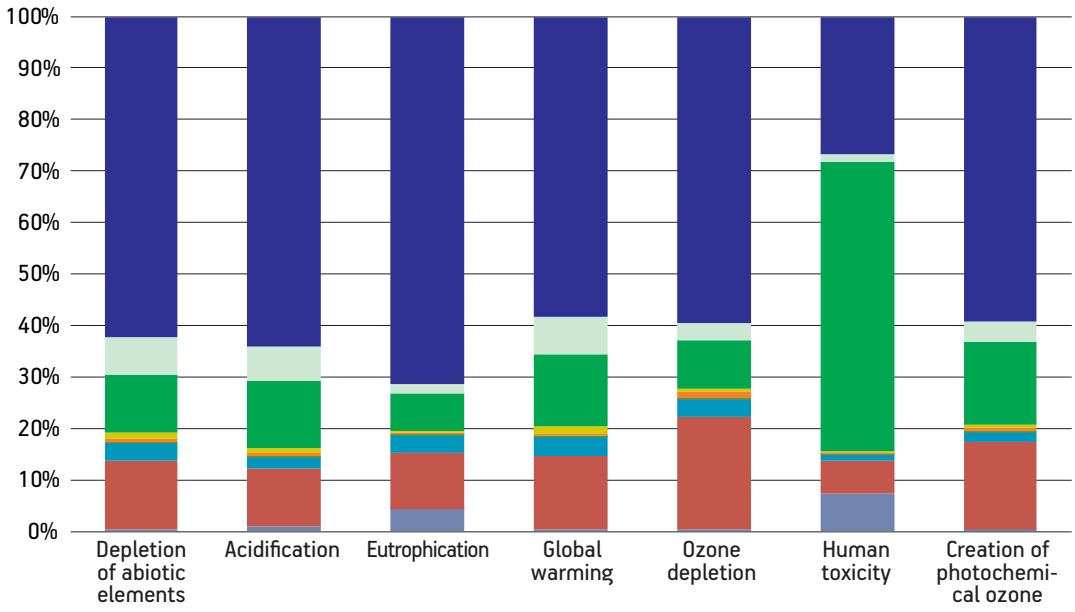
The entrances and exits in the printing process come from a printer that applies good environmental practices, and therefore, makes good use of resources like energy and water. If the data had been extracted from the standard processes on the Ecoinvent database, the energy and water use would have been very high, and therefore a higher environmental impact. This shows how important it is to introduce good environmental practices into the printing process.

## Book. Distribution of the environmental impact in the considered categories and the life cycle stages




| | Depletion of abiotic elements | Acidification | Eutrophication | Global warming | Ozone depletion | Human toxicity | Creation of photochemical ozone |
|---|---|---|---|---|---|---|---|
| Raw materials | 51.9% | 47.8% | 55.4% | 49.4% | 51.4% | 19.4% | 41.2% |
| Design | 10.1% | 10.5% | 3.2% | 9.6% | 4.7% | 2.0% | 6.5% |
| Plate manufacturing | 14.7% | 19.1% | 12.2% | 17.6% | 12.4% | 64.4% | 23.9% |
| Plate setting | 1.5% | 1.6% | 0.7% | 1.7% | 0.8% | 0.3% | 1.1% |
| Printing | 0.5% | 0.5% | 0.2% | 0.4% | 1.1% | 0.2% | 0.5% |
| Finishes | 1.9% | 1.9% | 1.7% | 1.4% | 0.1% | 0.2% | 1.0% |
| Packaging | 3.2% | 2.3% | 4.2% | 3.2% | 3.3% | 1.1% | 2.0% |
| Distribution | 16.1% | 15.3% | 17.2% | 16.4% | 26.0% | 6.8% | 23.2% |
| Waste treatment | 0.2% | 0.9% | 5.1% | 0.3% | 0.3% | 5.7% | 0.5% |

**MAGAZINE. DISTRIBUTION OF THE ENVIRONMENTAL IMPACT IN THE CONSIDERED CATEGORIES AND THE LIFE CYCLE STAGES**




| | Depletion of abiotic elements | Acidification | Eutrophication | Global warming | Ozone depletion | Human toxicity | Creation of photochemical ozone |
|---|---|---|---|---|---|---|---|
| Raw materials | 62.3% | 64.0% | 71.6% | 58.3% | 59.5% | 26.7% | 59.2% |
| Design | 7.3% | 6.8% | 1.8% | 7.3% | 3.4% | 1.7% | 4.1% |
| Plate manufacturing | 11.3% | 13.0% | 7.1% | 14.1% | 9.5% | 56.0% | 16.0% |
| Plate setting | 1.1% | 1.1% | 0.4% | 1.4% | 0.6% | 0.3% | 0.7% |
| Printing | 0.5% | 0.4% | 0.2% | 0.5% | 1.1% | 0.2% | 0.4% |
| Finishes | 0.1% | 0.1% | 0.02% | 0.1% | 0.03% | 0.03% | 0.1% |
| Packaging | 3.6% | 2.3% | 3.6% | 3.7% | 3.7% | 1.4% | 2.0% |
| Distribution | 13.6% | 11.4% | 10.9% | 14.4% | 21.9% | 6.5% | 17.0% |
| Waste treatment | 0.2% | 0.9% | 4.4% | 0.3% | 0.3% | 7.3% | 0.5% |

As we have previously said, apart from the impact categories, the following indicators were also analyzed: total demand for energy, use of water and total green house effect gas emissions. Here are the results:

**For the book**

Accumulated energy demand:
**9.16 equivalent mega joules (MJ eq.)= 2.54 kWh**
Total greenhouse effect gas emissions: **476 g of $CO_2$ eq.**
Water use: **6.76L**

**For the magazine**

Accumulated energy demand:
**9.76 equivalent mega joules (MJ eq.)= 2.71 kWh**
Total greenhouse effect gas emissions: **298 g $CO_2$ eq.**
Water use: **8L**

## Book and magazines carbon footprint

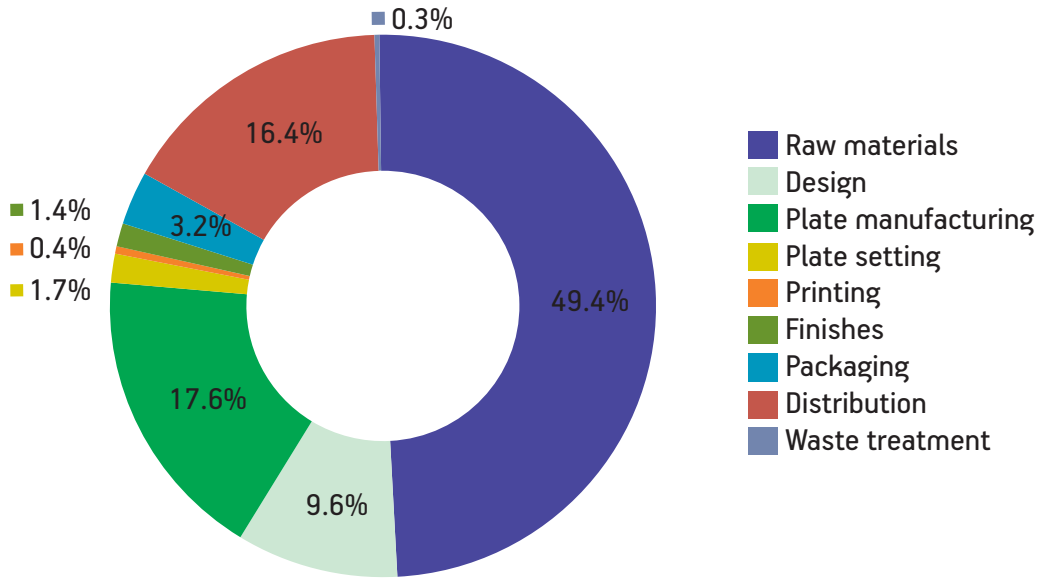
As well as the previously mentioned impact categories, emphasis has been placed on the calculation and analysis of one category: potential warming, to determine the carbon footprint of the two studied products. The results obtained are listed as follows.

### *Book (476 g $CO_2$ eq.)*

49.4% of the emissions come from obtaining the raw materials
17.6% from manufacturing the plates
16.4% from the distribution stage
9.6% during the design.
The other stages of the life cycle that were considered (plate setting, printing, finished, packaging and waste treatment) contribute to 7% of the total emissions.



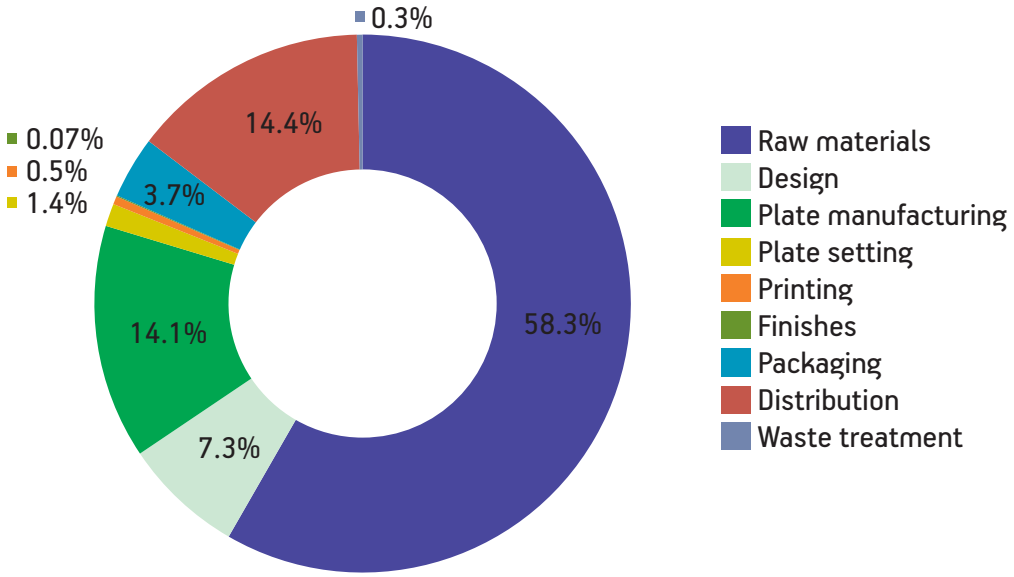
**Book.**
**Climate profile. Origen of $CO_2$ eq. Emissions during each stage**




### *Magazine (298 g de $CO_2$ eq.)*

58.3% of emissions came from obtaining the raw materials
14.1% came from manufacturing the plates
14.4% from the distribution stage
7.3% during the design
The other stages of the life cycle that were considered (plate setting, printing, finished, packaging and waste treatment) contribute to 6% of the total emissions.

**Magazine.**
**Climate profile. Origin of $CO_2$ eq. emissions during each stage**





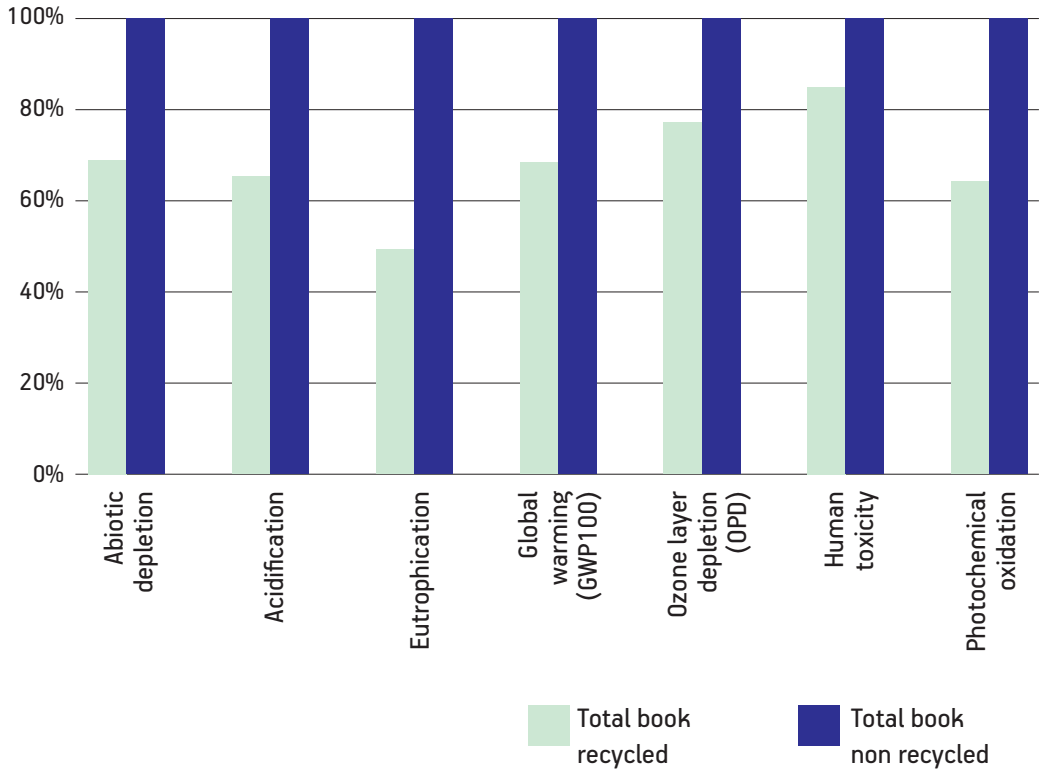

## Environmental impact of the raw materials

The raw materials considered in this study are paper and ink, the main components of a printed book and magazine. Just as has been noted in the previous point, the raw materials have the most significant environmental load (49.4% in the case of the book and 58.3% in the case of a magazine).

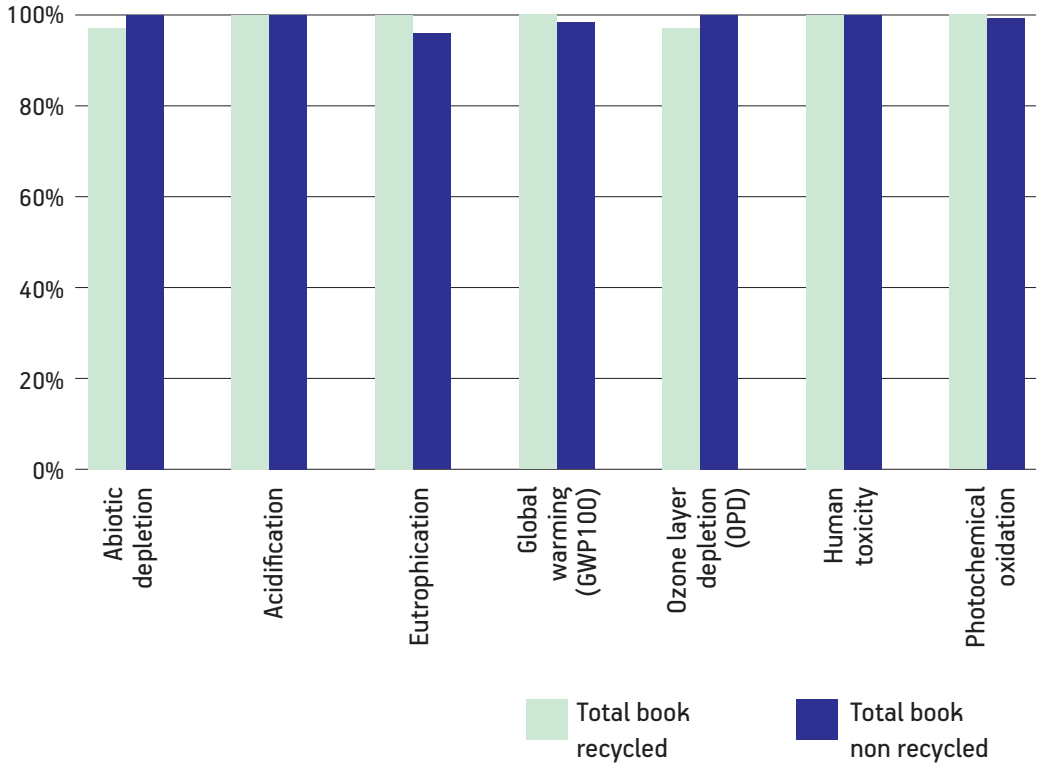
### Comparison between recycled paper and virgin fibre paper

Books and magazines manufactured with recycled paper have less environmental impact, as in this way they avoid using new virgin fibre paper, and therefore save the impact that producing it would cause.

### Book. Comparison between a book made with recycled paper and one made with non recycled paper




### Comparison between a book made with vegetable oil based inks and one made with mineral oil based inks



A comparative analysis has also been made between using mineral oil based inks and vegetable oil based inks for a book and a magazine. Even though when comparing the vegetable and mineral inks significant environmental benefits are seen, when these come to form part of the final product, the publications environmental impact does not change a lot, as a very small amount of ink is used in the product.

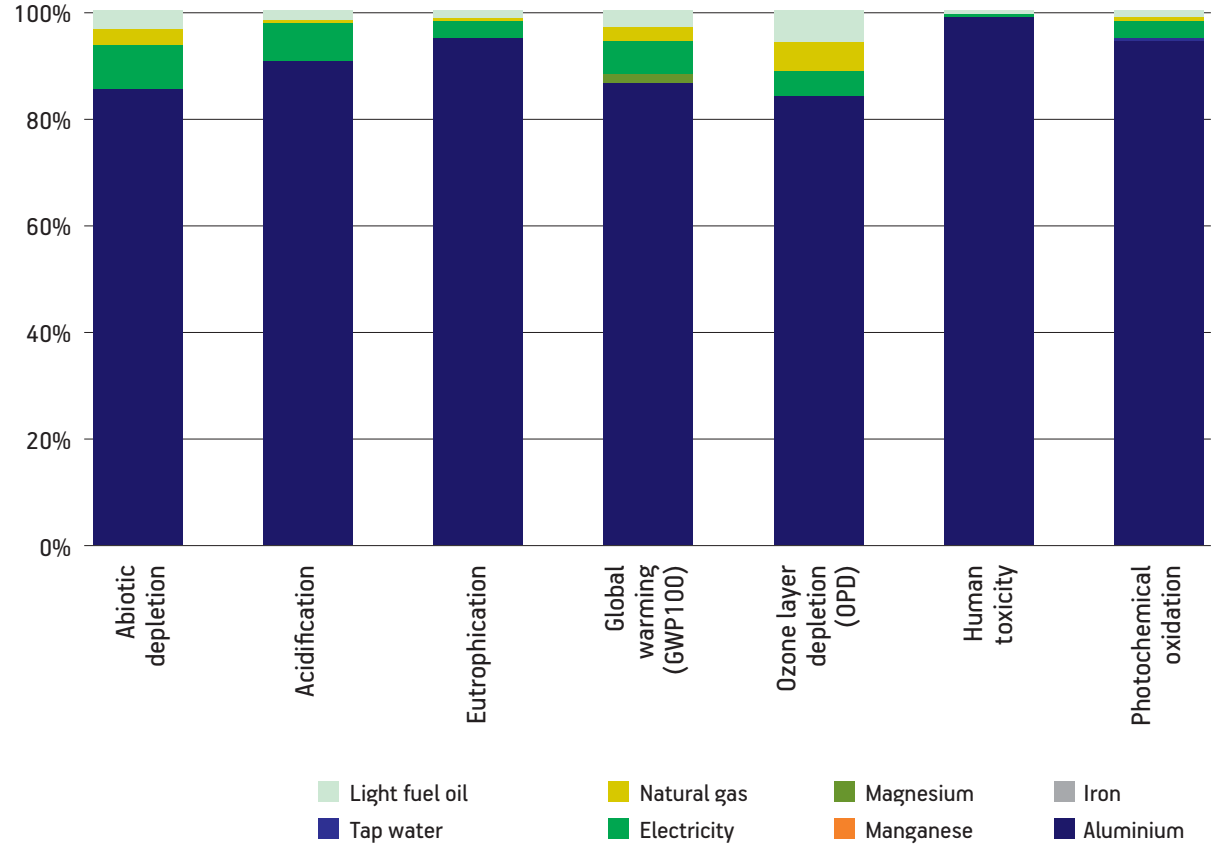
### Environmental impact of plate manufacturing

Plate production contributes 23% (on average) to the environmental impact of a book in the studied categories. For a magazine it has a contribution of 18% (on average) of the global impact within the studied categories.

The environmental impact that the production of the plates generates is due in a great part to their main component: aluminium.



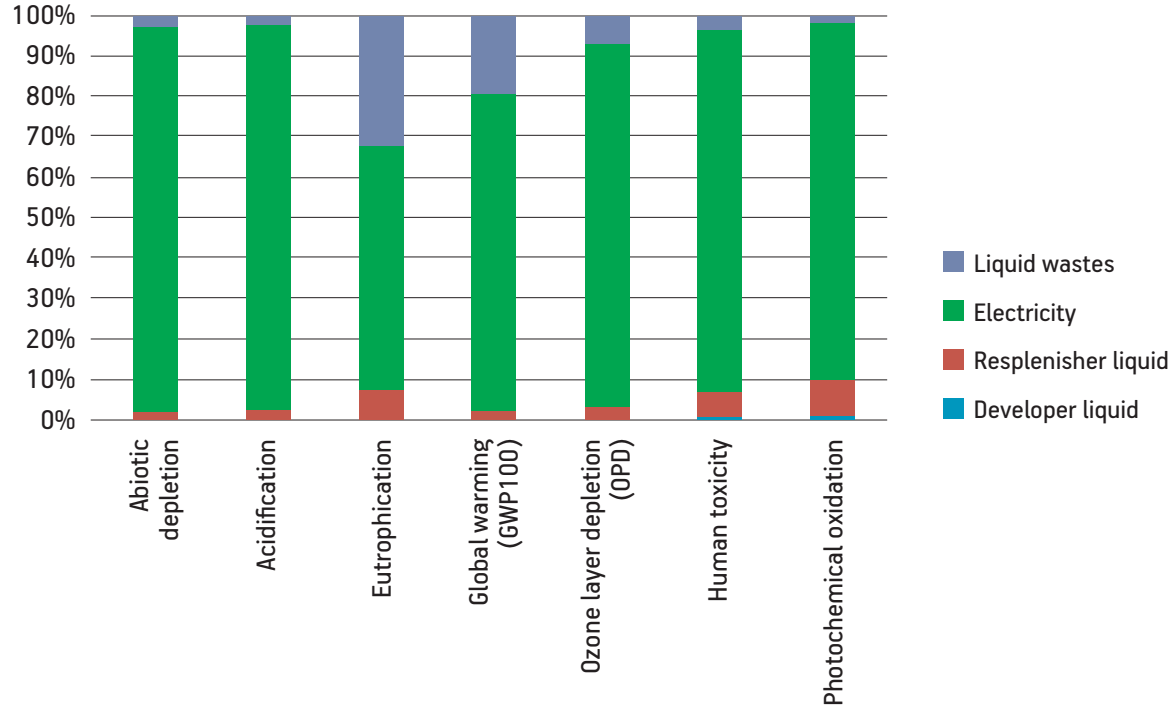
**Book and magazine. Plate production impact**



## Environmental impact of plate setting

Plate setting has a low impact in the global environmental analysis of a publication, thanks to the improvements in the new systems like CtP (computer to plate) in which the amount of chemicals used is minimized. If the plate setting process is analyzed it can be seen that a high percentage of the impact comes from the use of electricity.

**Plate setting impacts**

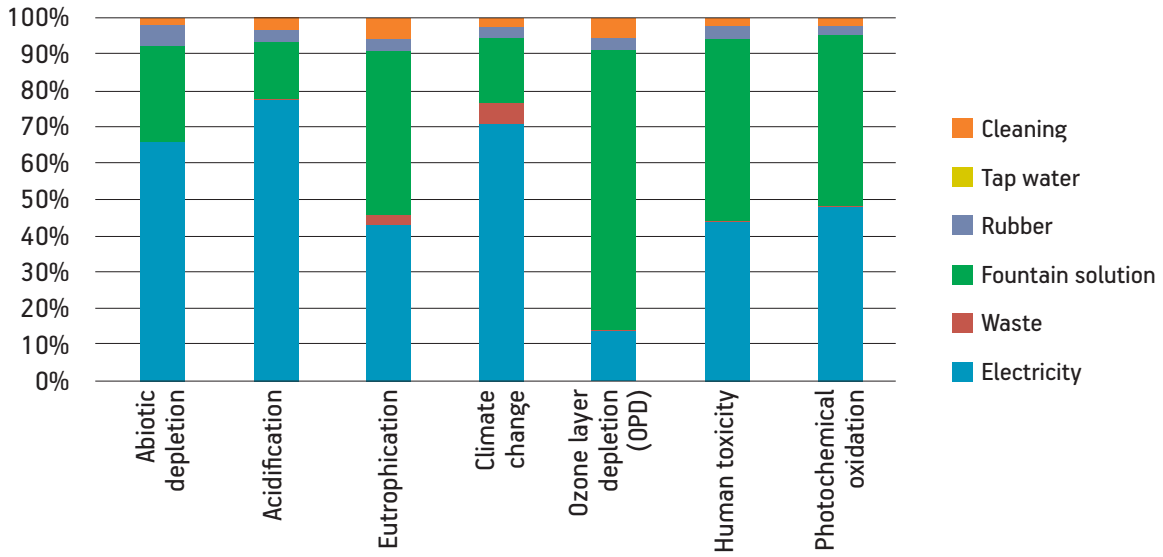





## Environmental impact of the printing stage

Printing, compared to the other stages, has a low environmental impact. If the process is observed individually, it can be seen that the energy used makes up the most important part of the environmental impact, followed by the dampening solution that contributes largely to the deterioration of the ozone layer.

**Impact of the printing stage**

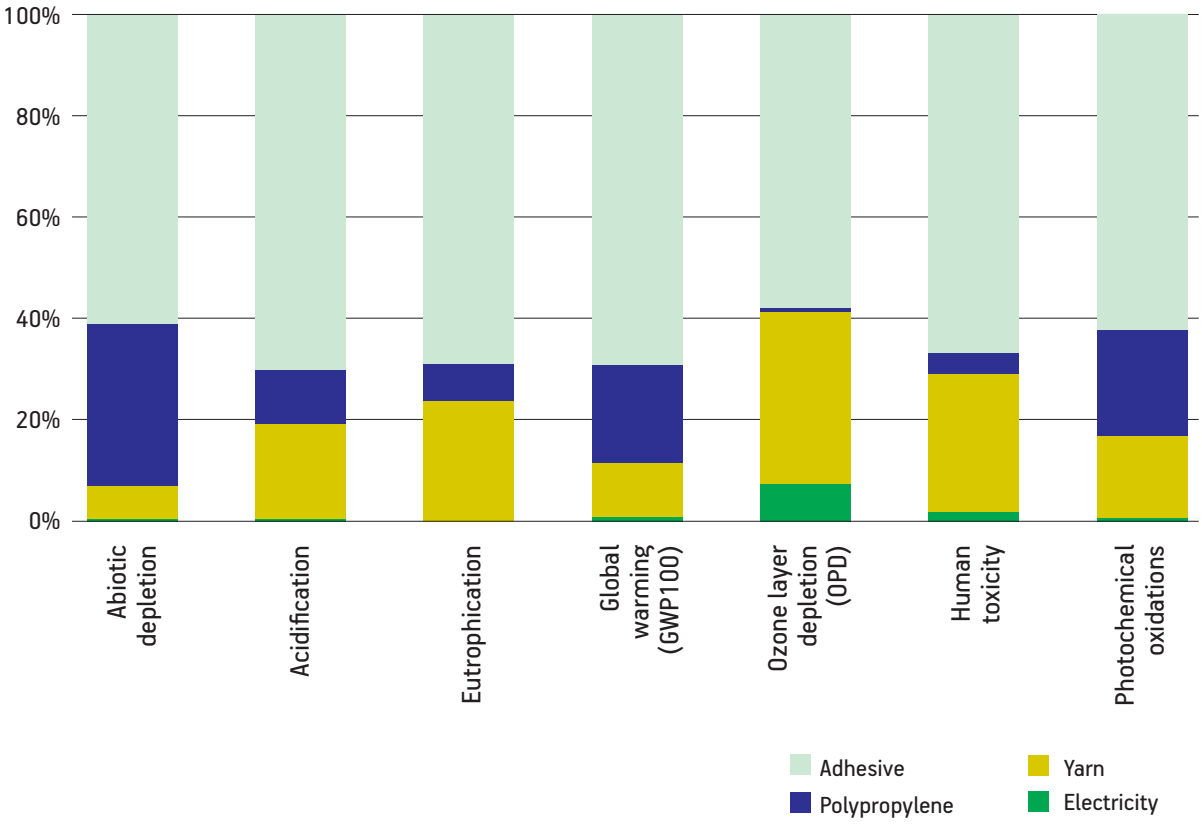





## Environmental impact of the finishing stage of a book

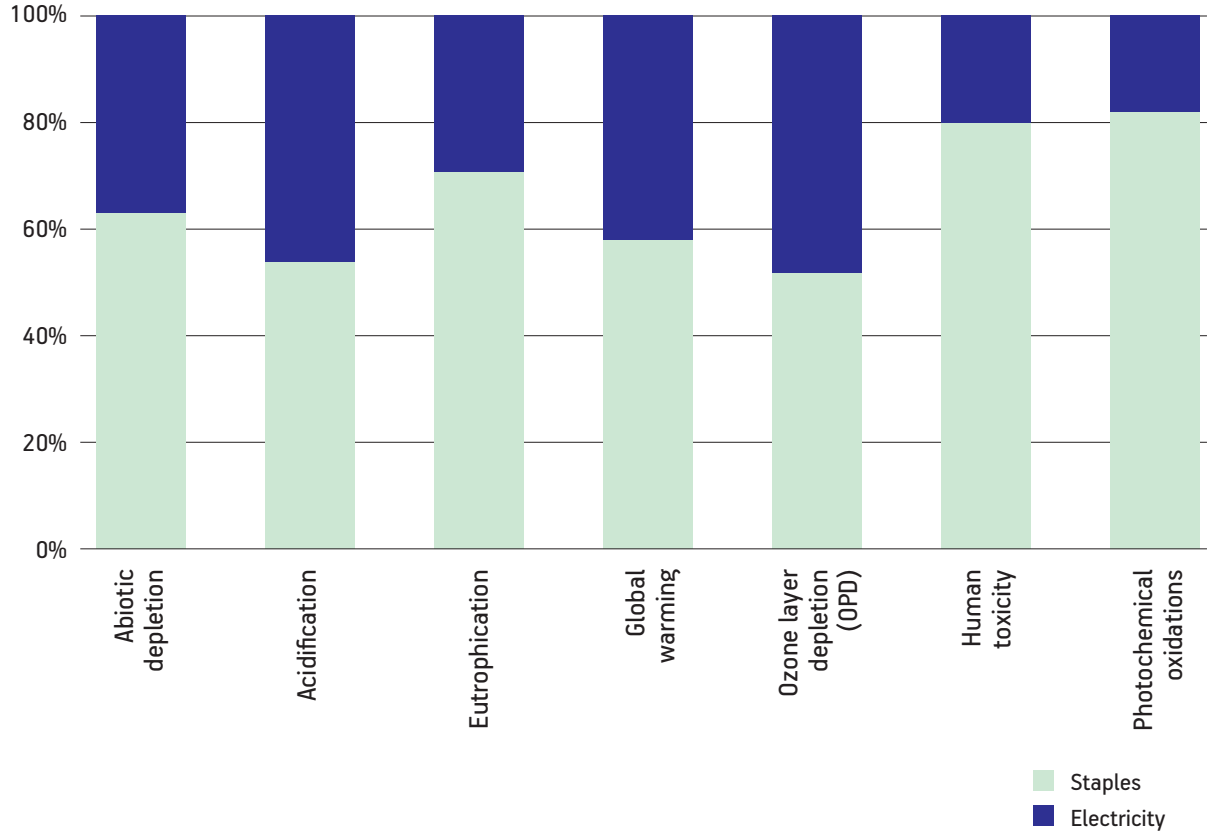
With the book, the environmental impact for this stage comes from the high percentage of adhesive used. Other materials (string and polypropylene) have a low contribution in all the impact categories considered.

**Impacts in a book's finishing stage**



The impacts in a magazines finishing stage are mainly due to the metal staples and use of electricity.

**Environmental impact in the finishing stage of a magazine**



The life cycle stage of a book or magazine that individually has the most environmental impact is the production of the raw materials (paper and ink). Therefore, it is important to introduce environmental criteria when it comes to choosing them.

We must highlight, however, that more than half of the environmental impact of a book is associated with the other stages of its life cycle. The printing, design and finishing stages bear an important weight on the distribution of the products' environmental load, as can be seen in the charts shown previously.

The design stage, even though having a very low direct environmental impact, is very important, as it is the moment in which one of the many key decisions for the product is made: the choice of raw materials. Therefore, this stage is the one that can most influence the possible minimisation of a book or magazine's environmental impact.



The plate manufacturing and setting also plays an important part in a books environmental impact.

In the design and printing stages, a great part of the impact is due to energy use.

The results of the life cycle assessment help us to see the potential environmental impact of a product, but we must take care when interpreting the results, because hypothesis are made during the analysis that can limit the reliability of the results. As well as the LCA, other factors, like economic and social factors must be taken into account.

# 4. Raw materials



## Paper

Paper and cardboard are made from cellulose fibres and other chemical products. The fibres are obtained from the wood of trees but also from other plants like rice, bamboo, hemp, cotton, esparto grass and linen. Wood is made from cellulose and lignin, this last ingredient providing the rigidity that helps keep the cellulose fibres together.

To produce fibres from wood a chemical or mechanical technology is used, the result is called pulp or paste. Chemical paste is obtained with a chemical process that separates the lignin from the cellulose. Kraft or sulphate chemical paste (basic process) and sulphite (acid process) are used. The mechanical paste is obtained from simply grinding the wood without eliminating the lignin.

Chemicals are added to the paste to obtain certain paper features; for shine and opacity calcium carbonate limestone rocks are used as well as clay with kaolinite and starch. Among the fillers and additives are china clay, talc, calcium carbonate and titanium dioxide. They are white, fine mineral particulates that have the objective of improving the physical, visual and printing properties that denser, whiter, smoother and more opaque paper provide. These additives can come to make up 30% of the final weight of the paper.

In the finishes, as well as in the processing, other chemical products are introduced into the paper in a lower proportion: with a threshold of 2% of the final weight. These are resins, chlorine, coating inks, retention agents, cleaning agents and others.

The pasting agents offer resistance to penetration by fluids, dry resistance adhesives (starches and rubbers) – that help increase the paper's tensile strength and detachment resistance – wet resistance resins (melanin-formaldehyde and polyamides) – that increase the papers resistance when it gets wet – and colouring materials (pigments) optical whiteners, microbicides, etc.

Directive 94/62/CE from the European Parliament and Commission on the 20$^{th}$ of December 1994, relating to containers and container waste, ensures

that the concentration of heavy metals like lead, cadmium, mercury, and hexavalent chromium are not present in containers or their components in percentages higher than 100ppm (parts per million). This has led to the creation of the Heavy Metal Absence insignia that is included in paper that fulfils this directive.

**Recycled Paper**

Recycled paper is obtained from a process of recuperating waste paper using the following phases: recovering the waste, weight and documentary management; storing, classifying paper and cardboard (manually or automatically); shredding and cutting; compacting (pressing) and bailing, storing by categories, dispatch and inappropriate materials.



El Tinter, one of the Greening Books Projects' three partners, took part in a study about paper saving by the Red Compra Reciclado (Buy recycled Network). From the results obtained, they could work out the savings from using recycled paper for the covers of the books produced Pol.len Edicions, publisher linked with El Tinter. If a book cover of 0.230 kg was used, the saving was of 2.1 $CO_2$ eq. per kilo of recycled material.

**Forestry certification**

Primary forests, extensive forests that have not been industrially exploited, are the pinnacle of continental life. Even though they only cover 7% of the world's land surface, they shelter at least half of all living species. This biological wealth has been used to the full in many different ways by a large number of people and communities that depend on them and that have taken part in moulding them.

Only 20% of the original primary forests remain, these have been threatened specially by large scale logging, a lot of which is illegal. A substantial part of this destruction ends up in our hands in the form of virgin fibre paper or white paper: most of the timber harvested to make paper comes from plantations, which have in many cases substituted primary forests, often with negative impact on the local population. 17% of paper pulp still comes from primary forests; 54% from secondary forests and 29% from plantations.

Against this backdrop, forestry certification is the answer. To certify is to give witness, by the corresponding certificate, that a product or service meets certain rules or technical specifications, with predetermined targets. Lasting forestry certification seeks to draw the consumer's attention to the environmental impact of the felling of forests that can be reduced by boosting a sustainable forestry that is especially respectful with wild forests.

Forestry certification aims to link international trade of forestry produce with the sustainable management of these goods, products and services.

The certification from the Forest Stewardship Council (FSC) comes from an agreement between producers, environmental associations and local communities; the absence of a public system of forestry accreditation in Europe has favoured the appearance of private accreditations. FSC, forestry certification is based on ten principles and fifty-six criteria. FSC promotes an environmentally responsible, socially beneficial and economically advantageous forestry management all over the world.



The PEFC, Program for the Endorsement of Forest Certification Schemes is not backed by the main environmental organizations for different reasons.

## A common vision

On the 2nd of October 2005, the European environmental movement group approved a document during the European Forestry Movement that took place in Brussels. The importance of the document, A Common Vision for transforming the European paper industry, lies in the solidification of the demands and the unification of its objectives for a cleaner production of paper products, moderation of use and the need to recycle. It also represents resolute support for the Forestry Management Counsel as the issuer of the only international certification pregame that approaches the goal of an environmentally and socially responsible management and restoration. As well as this the EEPN, European Environmental Paper Network, prime mover behind the manifesto, specifies that they do not recommend backing the following forestry certifications: PEFC, SFI, MTTC, CSA, CERTFOR and CERFLOR.

### Whitening with chlorine

Elemental chlorine (liquid) and chlorine dioxide (gas) were and are used in the paper industry to whiten the pulp because they give the paper a bright white appearance and eliminate the lignin, a natural component of larger woody plants that acts as cement in the structure of their fibres.

Both forms of chlorine produce dioxins, an extremely dangerous carcinogenic. It must be said that chlorine dioxide ($ClO_2$) produces less dioxins, but it is also a combustible gas. Hundreds of organochlorinated compounds are generated from chlorine, these are unknown organic molecules, some toxic,

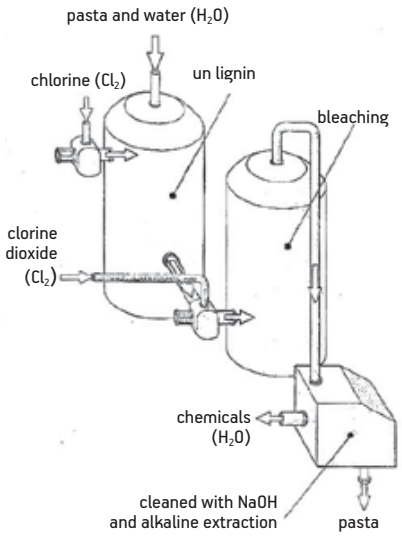
## The hierarchy of the fibre extraction and whitening processes

| Process | How it works |
|---|---|
| Chlorine free process (PFC) Totally chlorine free (TCF)* | Completely substitutes chlorine compounds with oxygen based compounds. |
| Elemental chlorine free (ECF), improved with ozone and hydrogen peroxide | Uses ozone or hydrogen peroxide as a whitening agent in the initial stages of the whitening process (in the final stages chlorine dioxide is used). |
| Elementary chlorine free with extended delifignation or oxygen (improved ECF) | Eliminates a larger amount of lignin before the whitening, this way reducing the use of energy and chemical substances during the whitening process (in the final stage chlorine dioxide is used). |
| Elemental chlorine free (traditional ECF) | Substitutes elemental chlorine with chlorine dioxide. In the USA elemental chlorine was eliminated in 2001. |
| Elemental chlorine | Uses elemental chlorine to whiten the pulp. |

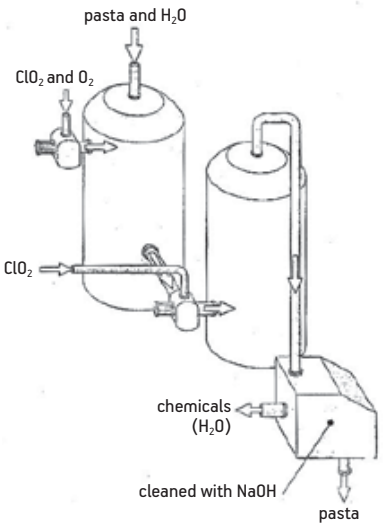
* PFC and TFC refer to paper made without bleach. PCF paper contains recycled fibre that could contain traces of chlorine. TCF refers only to 100% virgin paper.
Source: *El paper.* Museu de la Ciència i la Tècnica de Catalunya. Terrassa, 2006 (Biodiversitat i Tecnodiversitat).



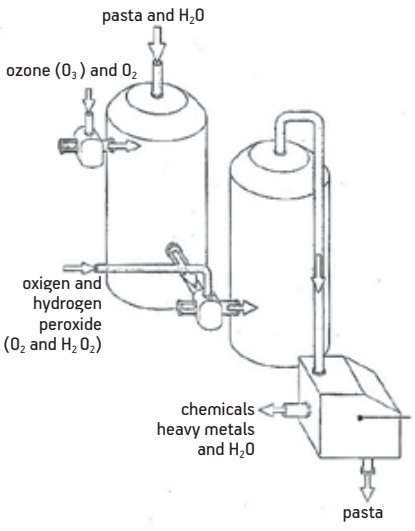
### Conventional Bleaching with chlorine ($Cl_2$)




### ECF Bleaching




### TCF Bleaching



some very toxic, persistent and bio-accumulative, and that effect human livers and immune systems.

Since there have been alternatives to chlorine whitening, many professionals dedicated to public health have requested liquid chlorine and chlorine in general to be banned and technologically replaced. At present, in Spain, in nearly all the production of pulp, elemental bleach is not used as whitener, instead EFC chlorine dioxide is used, or the chlorine has been substituted in the process (PCF and TCF), thus proving that substitution of this toxin is possible.



## Inks

Ink is a homogeneous mix of pigments (colouring materials), bonding agents, solvents, waxes and additives. Conventional inks are made with oils derived from petroleum, a combination of pigments and bonding agents (substances that help the pigments adhere to the paper) and the agent used to retain and transport the pigment, varnish.

Pigments are added to the ink to produce colours. In making them, heavy metals may be included, like barium, copper or zinc. These metals are a hazard to the people that come into contact with them. Prolonged exposure is a problem, so is water contamination by industrial waste. Regulations and investigation have reduced the presence of heavy metals. Directive 2007/1/CE, relating to the integrated prevention and control of contaminants (IPPC) regulates heavy metals that are listed as contaminating substances that must be taken into account when setting the limit values for emissions.

On the other hand, the REACH ruling maintains all the existing restrictions referring to heavy metals that are collected in annex XVII of the ruling.

## Composition of offset inks

The following composition of offset inks is the standard reference, but we must point out that it is an approximation and can vary.

| Composition | Percentage in weight |
|---|---|
| Pigments | 14.0 |
| Varnishes | 28.5 |
| Solvents | 53.5 |
| Additives | 5.0 |

**Pigments:** Can be organic or inorganic. The pigments included in the making of ink are susceptible to containing heavy metals. There are also pigments for metallic inks that contain a higher amount of metals. The metallic colour silver is made with aluminium pigments and the metallic gold with brass or coloured aluminium. Fluorescent inks are highly saturated. They absorb more visible light or ultraviolet light.

**Varnishes:** They transmit physical properties. They are resins and oils. Varnish, which is made with vegetable and or mineral oils and resins, is an essential component of ink; the pigments are dispersed in it. Varnish, also called vehicle, brings together the pigments and wets them, that is to say it recoats them. It also transports them - hence the name “vehicle”: the colouring material from the press to the paper or background.
When ink makes contact with the paper, the vehicle has a filmogenic effect: by using a film it assures the definitive fixation of the pigment to the paper by a process called drying.

**Solvents:** Are used to dissolve the varnishes and give the ink viscosity. Solvents are oils (mineral in the case of mineral inks or vegetable in the case of vegetable inks), aromatic and aliphatic hydrocarbons, esters and alcohols. In inks with vegetable oils, mineral oils are normally substituted with fatty acid esters.

**Additives:** The designation of additives includes, products that in small proportions have to be added to offset inks to adapt them to specific use conditions, to obtain new properties or to improve in some way those already existing. Common additives are waxes, blotters, antioxidants, anti set off powders, etc.

Source: Ecoinvent, Crosschecked with ink manufacturing companies.

**Types of ink used in graphic arts**

| Inks | Printing systems | Products |
|---|---|---|
| Synthetic oil inks<br>Vegetable oil inks | Offset coil | Publications<br>Containers and packaging |
| Synthetic oil inks<br>Vegetable oil inks<br>UV inks<br>Hybrid inks | Offset sheet | Publishers<br>Catalogs<br>Publications |
| Water-based inks<br>Solvent inks | Flexography | Containers<br>Packaging |
| Water-based inks<br>Solvent inks | Vacuum etching | Publishers<br>Publications<br>Containers<br>Packaging |
| Water-based inks<br>Solvent inks<br>UV inks | Serigraphy | Containers |

Source: *Bones pràctiques de disseny gràfic de producte Industrial imprès.* València: AIDO, 2009.



## Types of ink used in graphic arts

The presence of artificial volatile organic compounds (VOCs) is mainly influenced by the activities that use organic dissolvent.

Prolonged exposure to artificial VOCs can generate a risk depending on the intrinsic hazard of the substance and the time exposed to it. Following is a list of the risks that VOCs have on human health and the environment. The reduction of artificial VOCs is a hard to reach objective due to the lack of data and because of the few measures adopted in this area. Directive 1999/13/CE[2] has the aim of preventing or reducing the direct or indirect emissions from VOCs into the environment and upon human beings through setting emission limits for these compounds. Royal decree 117/2003, enforced from the 31st of October 2007, replaced Directive 1999/13/CE by the European Commission that limits the emissions of VOCs proceeding from the use of dissolvent in certain industrial sector.

2. Guideline 1999/13/EC 11th of March 1999, regarding the restriction of volatile organic compound emissions from the use of organic solvents in certain activities and instalations: eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:1999:085:0001:0001:ES:PDF.

The environmental impact of synthetic inks, both during the manufacture process and their use, are caused by the use of non-renewable raw materials, the emission of synthetic VOCs and generation of hazardous waste.

So as to act in this regard, the waste generated, the types of oil, the solvents, drying process and the chemical substances that make them up must all be considered.

**Risks to human health**

The health risks associated with the emissions of COVs from the use of organic solvents come from their volatile, soluble and inflammable toxic properties. The volatile character of solvents means that they quickly evaporate in the air and reach significant concentrated levels in enclosed spaces. The most important risks that these compounds present to humans are absorption through the skin and inhalation. Direct contact with the skin allows the solvent to enter the blood stream causing immediate and long-term effects. Inhalation is the most dangerous route of exposure, as the lungs are very efficient when it comes to distributing VOCs all around the body, so very elevated concentrations can be inhaled in a short period, this being the most difficult route to control.



**Risks to the environment**

The emission of VOCs into the atmosphere generates important environmental problems. Some VOCs contribute to the degradation of the atmospheric ozone layer, like methyl chloroform (1, 1, 1.trichloroethane), carbon tetrachloride, CFCs or HCFCs. However, the use of these compounds, because they destroy the ozone layer, is presently prohibited by the Montreal Protocol and regulation 2037/2000 of the European Parliament.

Additionally, VOCs together with $NO_x$, when in the presence of sunlight, act as pioneers for the formation of trophospheric or environmental ozone. Atmospheric contamination by ozone is a chronic problem of wide dispersal in all the European Union, to the point that there is a regulation that limits their levels: Directive 92/72/CEE, about atmospheric contamination by ozone that was transposed to Spanish law September 1995 by Royal Decree 1494/1995.

Simultaneously, there is extensive environmental legislation that applies to industrial activities that use dissolvent in their processes. We must highlight, among others, the following laws:

- *Law 34/2007 on air quality and atmospheric protection:* Includes VOCs in the list of atmospheric contaminators, and the use of solvent and other

products in the catalogue of potential atmospheric contaminant activities (in annex IV).
- *Law 16/2002, for the integrated control and prevention of contamination:* Its aim is to avoid, or when this is not possible, reduce and control emissions into the atmosphere, water and ground (including waste) that the most contaminating industries generate, with the objective of reaching an elevated level of environmental protection. The activities that use organic dissolvent are considered to have a high contaminating potential (annex I). VOCs are one of the substances taken into account to set the emission value limits established by the Law for each authorized installation.



As a conclusion, we must highlight, that while there is significant European legislation that controls and limits VOCs emissions, it is appropriate to be aware of the fact that use of these should be avoided in work places as well as the dumping into the environment of certain, very hazardous substances.

Wherever there are technically viable alternatives, we advise reducing the use of this type of substance though a company replacement plan which should have the following priority activities:

- Minimise the damaging effects to human health that classified substances have by substituting them with others: H350 (R45), H340 (R46), H350i (R49), H360F (R60) and H360D (R61) in accordance with article 5, section 6 of Directive 1999/13/CE.
- Minimize the damaging effects on the environment, when there is a risk of emissions from the substances classified as hazardous, substituting them for others: H400/H410 (R50/53).
- Slow the ozone layer destruction process by replacing substances that have the EUH059 (R59) hazard warning, particularly halogenated solvent which is totally or partially classified with hazard warning EUH059 (R59).

**Ink waste:** Excess inks are those that have not been in contact with other inks, in other words, that are not contaminated. It is possible to recycle them but the best thing to do is reuse them. Combined inks are those that have been used and have come into contact with other inks, dissolvent, and paper fibres. It is best to recycle them, a process that is based on filtration, reconditioning and remixing.

**Types of oil:** Oils with a mineral base can be hazardous to human health and the environment; those with a vegetable base are derived from seeds like soya or hempseed, called flax. Inks made with vegetable oil dry by absorption, different to the evaporation process of the synthetic ones, derived from hydrocarbons. Therefore, those with a vegetable basis do not generate synthetic VOCs and enable de-inking if the paper is made of recycled fibres.

**Types of base:** Inks with a solvent base (alcohol) emit artificial VOCs from the solvent. Water based inks reduce the presence of synthetic VOCs but need a more thorough cleaning than solvent inks.



**Drying process:** Treated or energy cured refers to inks and coatings that get harder by being exposed to radiant energy. Inks that can be treated by energy are not made up of conventional dissolvent and therefore do not emit synthetic VOCs.

If the energy used is ultraviolet light, they are called UV inks. The drying is produced by the polymerization of a product that is photosensitive to short-wave radiations (ultraviolet radiation); this begins a hardening process though a chemical reaction. If the energy used comes from high energy accelerated electrons, concentrated in an electronic beam, they are called EB electronic beam inks. The drying is produced by the polymerization caused by the exposure to the digital beam. The risk of exposure to the operator demands the use of appropriate safety equipment.

**Composition:** The composition of the ink must be given due attention: if it contains chlorinated hydrocarbons or not, if it includes heavy metals like cadmium, strontium, hexavelant chromium (Cr +6), mercury or lead. In any case, water based inks have a low percentage of organic solvent.

Suppliers of chemicals (like inks) must by REACH regulation provide a security data file, for hazardous, persistent, bio-accumulative and toxic substances (PBT) or very persistent and bio-accumulative (MPMB), or for those included in the list of substances pending authorization. In these files all substances that pose a threat to human health and/or the environment must be listed.

Intermediate users must have at their disposal the last updated version of the security file and apply any risk management measures that are specified by the supplier.

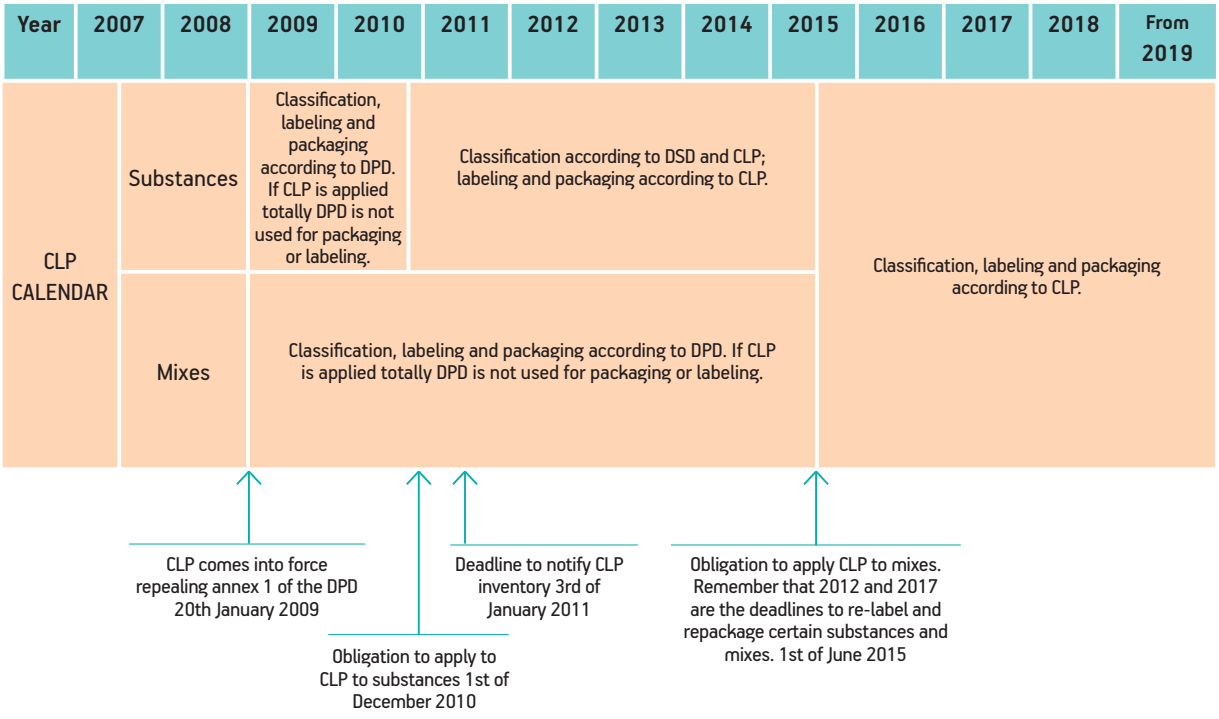
## Main pictograms of hazardous substances according the new EC Rule 1272/2008

EC ruling 1272/2008 regarding classification, labelling and packaging of chemicals and chemical mixes, better known as CLP, took effect on the 20th of January 2009 and involves a change in terms of classification and labelling of chemicals that is based on the system that has been globally harmonized by the United Nations.

The CLP regulation is progressively replacing the 67/548/CE directive regarding the classification of hazardous substances and the 1999/45/CEE directive regarding the classification, packaging and labelling of hazardous mixes (DPD). A period has been set, until the 1st of June 2015 when the two directives mentioned will be replaced by the CLP.



The double classification of hazardous substances will be obligatory from the 1st of December 2010 until the 1st of June 2015. The labelling and packaging of hazardous substances will be carried out in accordance with the CLP regulation from the 1st of December 2010. Both classifications must be mentioned in the technical sheets, but they must be labelled and packaged only in accordance with the new system. Hazardous mixes must be classified, labelled and packaged in accordance with the CLP ruling from the 1st of June 2015.




Source: Inforeach. Generalitat de Catalunya. Departament d'Empresa i Ocupació. (Generalitat de Catalunya's Business and Employment Department).

The CLP regulation has, among its main objectives, the determination of whether a substance or mix has properties that should be classified as dangerous. Once these properties are identified and the substance or mix classified as a consequence, the detected hazards must be communicated on the label. This basically implies:

- Establishing new classes and categories of hazard.
- Using warning words that set the hazardous level of the substance or mix.
- Introducing new pictograms.
- Setting hazard indications ("H") equivalent to the old sentences "R".
- Setting cautions "P", equivalent to the old sentences "S".



***Warning words***

Warning words that indicate the relative level of the hazards severity:

- *Danger*. Associated with the most serious categories.
- *Warning*. Associated with the least serious categories.

These warning words substitute the previous hazard indicators ("E", "O", "F", "T", "Xn", "Xi" and "C").

***Pictograms***

Danger pictograms, that have the aim of conveying specific information about the associated danger, are graphic compositions made up of a black symbol on a white background set in a red box that rests on one of its corners. The new pictograms are represented in the following box:


Source: *Instituto Nacional de Seguridad e Higiene en el Trabajo - Ministerio de Trabajo e Inmigración*.
(National Institute of Security and Hygiene at Work - Ministry of Work and Immigration).

***Danger indicators***

A danger indicator is a sentence that, assigned to a class or category of determined danger, describes the nature of the danger of a hazardous substance or mix. The danger indicators (equivalent to the old "R" sentences) are known as "H" (for hazard) and are grouped as follows:

- physical hazards
- hazardous to human health
- hazardous to the environment

68 In the CLP ruling, they have also included, supplementary hazard indicators, to cover certain types of danger not considered in the globally harmonized system (GHS). In front of the corresponding "H", they must also have the initials EU.

***Cautionary advice***

The old "S" security phrases are now cautionary pieces of advice that are grouped as follows:

- general
- preventative
- responsive
- storage
- disposal

In total there are more than one hundred cautionary guidelines

Following is a comparative chart between the old EU classification system and the new CLP regulation. The chart has the objective of providing a quick and general glimpse of the differences between the two systems:

## PELIGROS FÍSICOS

| Clases de peligro y categorías de peligro* | Elementos de la etiqueta NUEVO** | | Elementos de la etiqueta ANTIGUO | |
|---|---|---|---|---|
| Explosivos<br>• Explosivos inestables<br>• Explosivos divisiones 1.1 a 1.3<br>Sustancias/mezclas que reaccionan expontá neamente, tipo A, B<br>Peróxidos orgánicos, tipos A, B |  | H200<br>H201, H202, H203<br><br>H240, H241<br>H240, H241 | Peligro |  (R2, R3) | Peligro |
| Explosivos, división 1.4 |  | H204 | Atención | Sin clasificación | |
| Gases inflamables, categoría 1<br>Aerosoles inflamables, categoría 1<br>Líquidos inflamables, categoría 1 |  | H220<br>H222<br>H224 | Atención / Peligro |  (R12)<br>(R12)<br>R12 | Extremadamente inflamable |
| Líquidos inflamables, categoría 2<br>Sólidos inflamables, categoría 1<br>Sólidos inflamables, categoría 2 | | H225<br>H228<br>H228 | |  R11<br>(R11)<br>(R11) | Fácilmente inflamable |
| Aerosoles inflamables, categoría 2<br>Líquidos inflamables, categoría 3 |  | H223<br>H226 | Atención | Sin símbolo (R10)<br>R10<br><br>Sin clasificación.<br>Punto de inflamación 56-60°C | Inflamable |
| Líquidos pirofóricos, categoría 1<br>Sólidos piurofóricos, categoría 1<br>Sustancias/mezclas que, en contacto con el agua, desprenden gases inflamables, categorías 1, 2 y categoría 3 | | H250<br>H250<br>H260<br>H261<br>H261 | Atención / Peligro |  R17<br>R17<br>(R15)<br>(R15)<br>(R15) | Fácilmente inflamable |
| Sustancias/mezclas que reaccionan espontá neamente, tipo B<br>Sustancias/mezclas que reaccionan espontá neamente, tipos C y D y tipos E y F<br>Sustancias/mezclas que experimentan ca lentamiento espontáneo, categoría 1 y categoría 2 |  | H241<br>H242<br>H242<br>H251<br>H252 | |  R12<br>R12 | Fácilmente inflamable |
| Peróxidos orgánicos, tipo B<br>Peróxidos orgánicos, tipos C y D<br>Peróxidos orgánicos, tipos E y F | | H241<br>H242<br>H242 | |  R7<br>R7 | Comburente |
| Gases comburentes, categoría 1<br>Líquidos comburentes, categorías 1 y 2 y categoria 3<br>Sólidos comburentes, categorías 1 y 2 y categoria 3 |  | H270<br>H271, H272<br>H272<br>H271, H272<br>H272 | Peligro/Atención |  R8<br>R8, R9<br><br>R8, R9 | Comburente |
| Gases a presión<br>• Gas comprimido<br>• Gas licuado<br>• Gas licuado refrigerado<br>• Gas disuelto |  | H280<br>H280<br>H281<br>H280 | Atención | Sin clasificación | |
| Sustancias/mezclas corrosivas para los metales, categoría 1 |  | H290 | Atención | Sin clasificación | |

Source: *Instituto o Nacional de Seguridad e Higiene en el Trabajo - Ministerio de Trabajo e Inmigración* (National Institute of Security and Higiene at Work - Ministry of Work and Immigration).

## PELIGROS PARA LA SALUD HUMANA

| Clases de peligro y categorías de peligro* | Elementos de la etiqueta NUEVO ** | | | Elementos de la etiqueta ANTIGUO | | |
|---|---|---|---|---|---|---|
| Toxicidad aguda, categorías 1, 2<br>• Oral<br>• Cutánea<br>• Inhalación |  | H300<br>H310<br>H330 | Peligro |  | R28<br>R27<br>R26 | Muy tóxico |
| Toxicidad aguda, categoría 3<br>• Oral<br>• Cutánea<br>• Inhalación | | H301<br>H311<br>H331 | |  | R25<br>R24<br>R23 | Tóxico |
| Mutagenicidad en células germinales, categorías 1A, 1B<br>Carcinogenicidad, categorías 1A, 1B<br>Tocicidad para la reproducción, categorías 1A, 1B<br>STOT*** tras exposición única, categoría 1<br>STOT*** tras exposiciones repetidas, categoría 1 |  | H340<br>H350<br>H360<br>H370<br>H372 | Peligro |  | R46<br>R45, R49<br>R60, R61<br>R39<br>R48 | Tóxico |
| Sensibilización respiratoria, categoría 1<br>Toxicidad por aspiración, categoria 1 | | H334<br>H304 | |  | R42<br>R65 | Nocivo |
| Mutagenicidad en células germinales, categorías 2<br>Carcinogenicidad, categoría 2<br>Tocicidad para la reproducción, categoría 2<br>STOT*** tras exposición única, categoría 2<br>STOT*** tras exposiciones repetidas, categoría 2 |  | H341<br>H351<br>H361<br>H371<br>H373 | Atención |  | R68<br>R40<br>R62, R63<br>R68<br>R48 | |
| Toxicidad aguda, categoría 4<br>• Oral<br>• Cutánea<br>• Inhalación |  | H302<br>H312<br>H332 | Atención |  | R22<br>R21<br>R20 | |
| Corrosión cutánea, categorías 1A, 1B, 1C |  | H314 | Peligro |  | R34, R35 | Corrosivo |
| Lesión ocular grave, categoría 1 | | H318 | |  | R41 | Irritante |
| Irritación cutánea, categoría 2<br>Irritación ocular, categoría 2<br>Sensibilización cutánea, categoría 1<br>STOT*** tras exposición única, categoría 3<br>• Irritación de las vías respiratorias |  | H315<br>H319<br>H317<br>H335 | Atención |  | R38<br>R36<br>R43<br>R37 | Irritante |
| • Efectos narcóticos | | H336 | | Sin símbolo | R67 | |

## PELIGROS PARA EL MEDIO AMBIENTE

| | | | | | | |
|---|---|---|---|---|---|---|
| Peligroso para el medio ambiente acuático, agudo, categoría 1<br>Peligroso para el medio ambiente acuático, crónico, categoría 1 |  | H400<br>H410 | Atención |  | R50<br>R50/53 | Peligroso para el medio ambiente |
| Peligroso para el medio ambiente acuático, crónico, categoría 2 | | H411 | |  | R51/53 | |

Source: *Instituto o Nacional de Seguridad e Higiene en el Trabajo - Ministerio de Trabajo e Inmigración*
(National Institute of Security and Higiene at Work - Ministry of Work and Immigration).

### Vegetable ink as an alternative

Inks made with vegetable oils (cotton, linen and especially soya seeds) become an alternative that help eradicate synthetic VOCs. There are also soya laser printer toners but only in black. In the eighties, the American Soya Association began a campaign to use soya in a multitude of areas, especially in the food industry, and to substitute mineral oil with soy. This replacement had a lot of success within graphic art companies, to the extent that presently 90% of newspapers in the United Stated are printed with inks that include different percentages of soya oil.

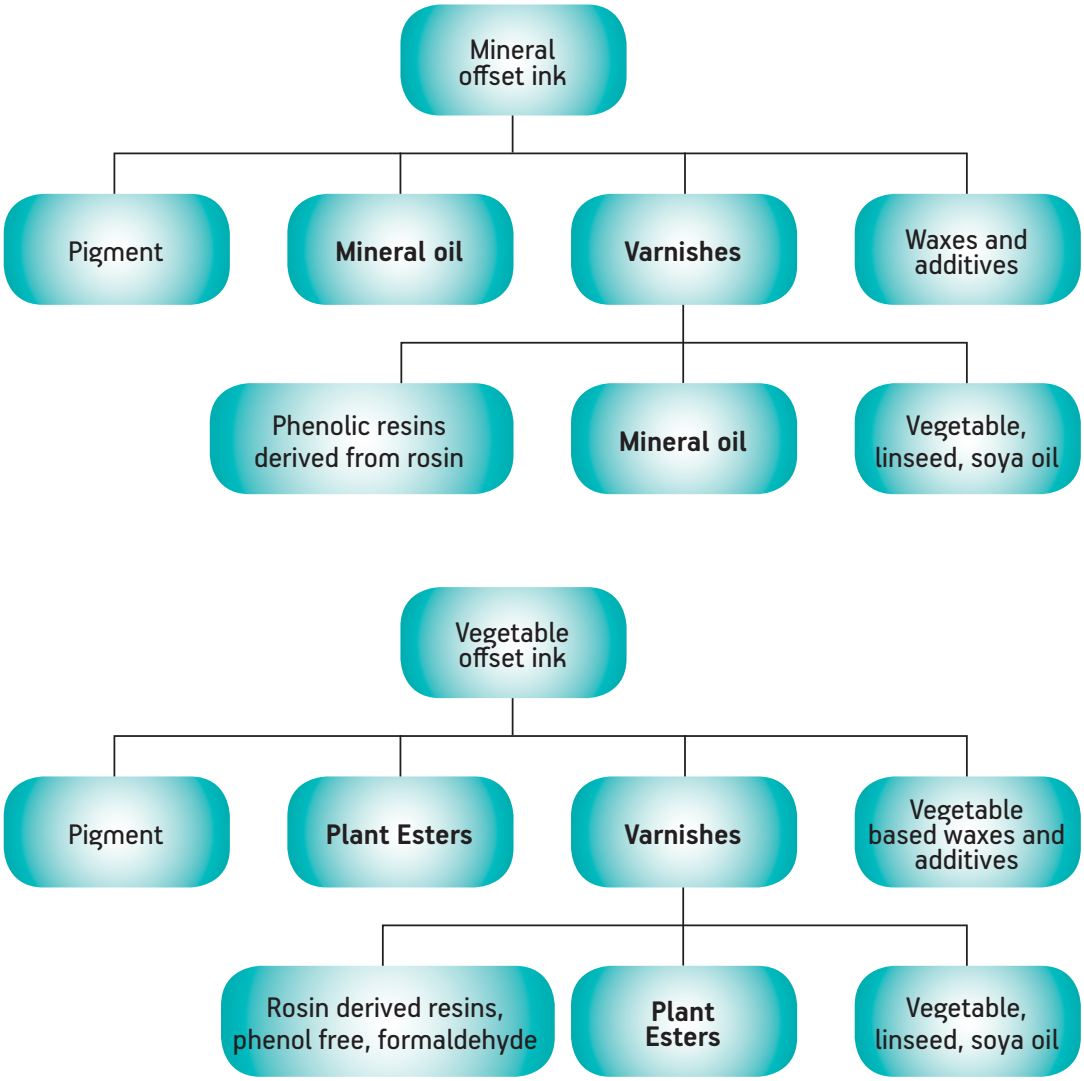
The environmental implications of soya cultivations in the poor southern countries, and the introduction of genetically modified soya seeds has brought about a reaction against the use of soya oils of these origins and along with this, uncertainty related to the genetically modified organisms (GMO).



It is important to clarify that the environmental objective is to eliminate VOCs, to reduce the use of renewable energies compared with the non-renewable petroleum ones and to introduce inks that reduce the specific waste and enable de-inking in the recycling process. It is rather hard to measure the problem as well as the real effects that the replacement of synthetic inks with vegetable inks is having. The actual composition of the inks is a mystery hidden under a veil of secrecy.

Vegetable oil inks use esters derived from vegetable oils as solvents, completely substituting mineral oils. According to the information from Tintas Ayala, the mineral components of varnishes, resins and waxes can also be substituted with other components of vegetable origin. Inks based on vegetable oil substitute all the mineral oil for vegetable oil (not just a small percentage).

### Mineral oils and vegetable oils in offset inks




Source: Javier Guerrero. "Martínez Ayala. Environmental Solutions in Offset Printing: Reduction of isopropilic alcohol and use of vegetable ink in offset printing". In: *Jornada "Sostenibilidad y competitividad en las imprentas y editoriales", 2012*

## Solvents

Synthetic solvent is a substance derived from petroleum that has been obtained by means of synthesis chemistry. The use of this dissolvent lies in its capacity to dissolve fats, oils and other substances that are not water-soluble. It is used in the cleaning of printing machinery and accessories. There are a great number of solvents, like ethylene acetate, toluene, Chilean, methyl ethyl ketone, heavy aliphatic hydrocarbons, etc.

The mix of different paints and solvents can have worse effects than those associated with each one individually. It's referred to as chemical substance synergy. This is why it is so important to replace or minimize them.

## Some solvents and their risks to human health

| Solvents and additives | Affected organs | Health Risks |
|---|---|---|
| Alcohols | | |
| Isopropyl alcohol | Eyes, mouth and respiratory system, central nervous system and skin | Irritation, drowsiness and dizziness |
| Aliphatic hydrocarbons | | |
| Hexanes (s) | Skin, mouth and respiratory system, peripheral nervous system | Numbness of the lung and chemical pneumonia |
| Petrol. Can include benzene, lead and ethylene dibromene | Skin, mouth and respiratory system, central nervous system | Irritation, narcosis, pulmonary oedema, stomach ache, nauseas, liver and kidney complaints |
| Aromatic hydrocarbons | | |
| Benzene (carcinogenic) | Skin, central nervous system, blood, liver and kidneys | Dermatitis, narcosis, leukaemia and aplastic anaemia |
| Toluene | Central nervous system, liver, mouth and respiratory system, kidneys and skin | Dryness, narcosis, coma, muscular weakness, kidney and liver conditions |
| Chilene | Mouth and respiratory system, skin, central nervous system and liver | Irritation, narcosis, pulmonary oedema, stomach ache, nausea, liver and kidney conditions |
| Chlorinated hydrocarbons | | |
| Chloroform (probably carcinogenic) | Skin, heart, liver, kidneys, eyes and central nervous system | Irritation, liver enlargement, heart failure, narcosis |
| Ketones | | |
| Acetone<br>Methyl Ethyl Ketone | Skin, mouth and respiratory system, central nervous system | Irritation, narcosis and dermatitis |
| Ethers | | |
| Methyl ethyl acetate<br>Ethyl acetate<br>Isopropelyne acetate | Skin, mouth and respiratory system, central nervous system | Irritation and narcosis |
| Glycols | | |
| Etylglycol | Skin, central nervous system and kidneys | Irritation, loss of appetite and blood cell disorders |
| Others | | |
| Turpentine | Skin, eyes, mouth and respiratory system and lungs | Irritation, pulmonary oedema, dermatitis, narcosis, seizures, kidney and bladder conditions |

Source: Vicente Amorós, Alfonso Gallardo and Ramiro García. *Guía de tintas y disolventes.* Madrid: Fundación para la Prevención de Riesgos Laborales y Federación de Servicios de UGT, 2001 (Guide to ink and solvents. Madrid: Foundation for Work Risk Prevention and UGT, Service Federation 2001).

## Replacement alternatives for solvents

The following graph summarizes processes and organic solvents used in the graphic art industry and the actual existing alternatives.

| Production process | Organic solvents | Alternative substitutes |
|---|---|---|
| Lens, screen and film cleaning | 1,1,1, trichloroethane, ethanol | 1% sodium carbonate solution |
| Antistatic products on films | 1,1,1, trichloroethane | Use antistatic films |
| Coupling in typesetting and publishing | 1,1,1, trichloroethane, naphtha | 1. Glue sticks<br>2. Wax<br>3. Double sided adhesive<br>4. Stretched screen |
| Film touch up | Toluene and ethanol | 1. Coloured water base cover using a feather or brush<br>2. Red cover for film negatives |
| Film developing solution | Ethylene glycol, methylene glycol, propylene glycol and derivatives | Using a developing solution without organic solvents. |
| Metal | 1,1,1, trichloroethane | Ethyl acetate and butyl acetate |
| Photopolymers | Ethanol | Water, using another type of plate |
| Offset plates | Ethylene glycol, methylene glycol, propylene glycol and derivatives | Water based developing solution without organic solvents, using another kind of plate |
| Plate touch up (with hydrofluoric acid) | Dimethyl formaldehyde | 1. Check and clean the film before exposure<br>2. Expose plate with diffusing sheet<br>3. Make a new plate |
| Printing plate, coupling plate to structure, (isocyanate) | Ethyl acetate, acetone | Assemble with incorporated elastic system. |
| Printing screen (printing emulsions) | Alcohols | 1. Check and clean the slides and films before exposure.<br>2. Use emulsion and re-expose. |
| Flexi printing plate glue coupling | Naphtha | 1. Double sided adhesive<br>2. Mechanical joint |
| Photopolymer plate developers | Butanol/ethylene tetracol | Naphtha/ethanol using another kind of photopolymer plate |

| | | |
|---|---|---|
| Vacuum engraving of photo-relief | Organic solvents | Water based developing solution, using another type of developing solution |
| Offset printing ink with solvent in an aerosol | 1,1,1, trichloroethane | In a flat mouthed pot straight on to the roller without organic solvent |
| Plate cleaning | White spirit | Water soluble cleaning powders. |
| Coupling of paper, repairing tears before printing | Hexane | Double sided sticky tape |
| Cleaning colour roller and other equipment (water emulsion) | Naphta, acetone and toluene | 1. Scrub with brush and hot water<br>2. Pressurized water |
| Cleaning of printers' surfaces | Kerosene | Hot water and soap |
| Treating surfaces after printing | Butyl acetate, ethyl acetate, chilene, toluene | 1. Colourless ink<br>2. Water based laminating products |
| Screen-printing, ink | Inks with solvents | 1. Water based inks<br>2. Plastisol inks |
| Screen printing, screen cleaning | Organic solvents | 1. Avoid the ink drying out<br>2. Water if effective |
| Photo printing | Ethanol, 2-propanol, ethyl acetate, MEK, toluene | Water based inks (with 5-25% organic solvents) and clean with water based products |
| Vacuum engraving | Toluene, naphtha | Water based inks and clean with water based products |
| Binding books with glue | 1,1,1, Trichloroethane, toluene, ethanol, ethyl acetate | 1. PVA adhesives with organic solvents<br>2. Heat cast |
| Treating surfaces and binding | Ethyl acetate, ethanol, toluene, 2- propane acetate | Water based products |
| Laminating | Acetone, MEK, ethyl acetate, 2- propane acetate | 1. Water based adhesives<br>2. Specific polyester sheet fixed on paper by heat<br>3. Co-extrusion |
| Using antistatic agents in aerosol format on the surfaces of binding machinery | 1,1,1, Trichloroethane | Flat mouthed pot or brush without organic solvents |

Source: Vicente Amorós, Alfonso Gallardo and Ramiro García. *Guía de tintas y disolventes.* Madrid: Fundación para la Prevención de Riesgos Laborales y Federación de Servicios de UGT, 2001 (Guide to ink and solvents. Madrid: Foundation for Work Risk Prevention and UGT, Service Federation 2001).

## Volatile organic compounds

Organic compounds are chemical substances that contain carbon and are found in all living beings. Natural ones come from flowers or vegetation in general and are called biogenic.

Artificial and synthetic organic compounds or VOCs, transform, as their name indicates into vapours or gases that are present in the atmosphere, and therefore have the capacity to spread, being carried by the wind and settle in people's lungs when they breathe in. As well as carbon, they contain elements like hydrogen, oxygen, fluoride, chlorine, bromium, sulphur or nitrogen. VOCs are released by the burning of fuels like petrol, wood, coal or natural gas. They are also released by solvents, paints, and other products that are used and stored at work places and homes.



Here are some examples of COVs:

- Natural: isoprene, pinene and limonene.
- Artificial: benzene, toluene and nitrobenzene; other examples of artificial VOCs are: formaldehyde, chlorobenzene, solvents like toluene, chilene, acetone and perchloride ethylene (or tetrachloroethylene), which is the main dissolvent used in the dry cleaning industry.

Many VOCs are commonly used in paint and lacquer solvents, moth repellents, air fresheners, products used on wood, aerosol substances, degreasers, automotive products and solvents used in the dry cleaning industry.

A great part of artificial VOCs are dangerous air contaminants. The import of artificial VOCs is in their capacity as harbingers of the tropospheric ozone and their role as destroyers of the stratospheric ozone. They contribute to the creation of the photochemical smog when they react with other atmospheric contaminants like nitrogen oxide ($NO_2$) and sunlight. This phenomenon occurs mainly in urban areas and leads to brown coloured atmospheres that are rich in ozone. Nitric oxide (NO) and nitrogen dioxide ($NO_2$) are the only nitrogen oxides present in the atmosphere that have been introduced by human activity.

### Toxic free companies

The use of raw materials generates all types of waste, like paper, inks and solvents that produce emissions into the atmosphere like volatile organic compounds (VOCs) and a contaminating load into the wastewater.

Substituting toxic substances is the objective in order to achieve toxic free companies, in this case workshops pertaining to the graphic industry. To help bring this about, there is a European guideline: REACH, the 1907/2006 regulation regarding registering, evaluating, authorizing and restricting chemicals and chemical mixes. REACH came into force on the 1st of June 2007.



To gather information on some thirty thousand chemical products, access is available to the ISTAS, Instituto Sindical de Trabajo, Ambiente y Salud (Trade Union Institute for Work, Environment and Health) information platform www.istas.net/risctox/RISCTOX, a database of hazardous substances that claims to offer clear, organized and concise information about the health and environmental risks from these chemical substances that can be present in the products that the companies manipulate or generate. One of the sections it includes is: "Replacement guide, step by step".

The process is made up of the following continual action steps that can be made by the workers and their managers under the direction of the work hygiene and prevention officers:

1. Identify the presence and exposure to toxic chemical products in the work environment.
2. Eliminate substances that can be eliminated and immediately replace with others.
3. Identify remaining risk sources.
4. Calculate the potential risk of remaining exposure.
5. Establish protection measures
6. Eliminate risk factors
7. Verification and assessment of obtained results

### Green Chemistry

Green chemistry – also known as sustainable, even though both words have a slightly different meaning – takes into account contamination prevention. It has been defined as the design, manufacturing and use of chemicals and processes that eliminate, or at least reduce artificial and synthetic toxic substances and waste production. In other words, green chemistry converges in the same field as the "Zero Waste" objective. Besides this, REACH has created a new air of debate and innovation that, in any case, should give birth to green chemistry in the graphic arts.

The objectives of green chemistry can be summarized with the four "Rs": reduce use, reuse raw materials, recycle and most importantly, redesign.

In 2000, Paul T. Anastas and John C. Warner defined the so-called Twelve Principles of green chemistry:

1. Preventing contamination is preferable to treating waste afterwards.
2. Chemical synthesis methods must be designed to maximise the incorporation of all materials used in the process into the end product.
3. Chemical synthesis must use and generate substances that have zero or little toxicity for human and environmental health.
4. Chemicals must be designed in such a way that their functionality and effectiveness are preserved while their toxicity is reduced.
5. The use of auxiliary substances must be avoided or minimized, and when these are necessary they must be harmless.
6. Energy demands must be minimised, and must be assessed by their economical and environmental impact. Synthesis methods must be carried out at atmospheric pressure and temperature.
7. Raw materials and natural resources used must preferably be renewable, whenever this is technically viable.
8. Processes based on direct reactions are preferable to those in which intermediate reactions are used.
9. Catalytic reactors must be as selective as possible so as to avoid creating unnecessary sub products, and they must be used in place of stoichio metric reactors.
10. Chemicals must be designed so that at the end of their useful life they do not remain in the atmosphere and, that their respective degradation products are harmless.
11. Analytical methodologies must allow for a real time process control to detect the possible creation of damaging substances.
12. Substances and the way they are used in a chemical process must be chosen so as to minimize the potential risk of chemical accidents, including leaks, explosions and fires.

# 5. Eco-design



The designer is of prime importance when it comes to guaranteeing that a graphic product has the least environmental impact possible. They must choose a design committed to quality and excellence that incorporates environmental criteria in an implicit and explicit way. This entails knowledge of all processes, both of the designer's behaviour during the creation process and of the production processes.

Ecological design is not a trend but an ethical process. That is to say, environmentalism can be voluntarily explicit, but it must be environmentally implicit. To consider a product or process with an environmental insignia, one must understand that it is not a concept that is on the sidelines of history or of the moment. The EMAS (EMAS or ISO 14006 on eco-design) are noteworthy as well as the influence they can have when it comes to understanding the processes, as they allow for a study of each phase and each material and for the investigation of these.

Now, in present circumstances, the most *ecological* is the one who achieves a substantial reduction of the use of resources from the cradle to recycling, who prefers to use renewable and recyclable resources, who enables reuse before recycling and promotes containment, which must not be confused with the creativity implicit in all eco-design processes.

Closing the loop wherever possible implies incorporating what we now call waste as another "nutrient" of the process. It is the metabolic concept of the processes, the products, the work places and the use. It involves substituting eco-efficiency (doing more with less) with eco-effectiveness: cradle to cradle more than cradle to grave.

It involves understanding the production centre, whether a workshop, a studio, a printers or a publisher, as a metabolism that uses energy, water and resources and that produces products and services, along with the corresponding solid, liquid and gas waste in the shape of direct and associated emissions.

It's said that the tree is the symbol of the next revolution. A tree is fertilized with its own leaves; it metabolically uses its waste as manure and feeds many

other species that find benefit and protection under its shelter. It becomes a deposit of the carbon and water it dispenses. It gives shade and refuge to half of the terrestrial biodiversity. There is symbiosis between the tree and other beings, from the bacteria that multiply its radial load carrying capacity to the plagues that feed other predators. Even though it can't move it never stops. It breathes, absorbing carbon dioxide, it captures the carbon, purifies the atmosphere from suspended toxic particulates, generates oxygen and expels it, prevents the rain from damaging the soil, flowers, reproduces, adapts to each season, etc.



Biomimecry (to imitate and copy natural processes) is a prodigy to admire, a venerable guide. We have often heard of the three "Rs". We must remember that they follow a hierarchical order, and the last action – not the first – is to recycle. That's to say, that first we have to reduce, then reuse and finally, as a last resort, recycle.

The UNEP, United Nations Environment Program, has popularized the six "Rs" so that they are developed during the design process, from the acquisition of raw materials, production, distribution, to its use and end of life, or beginning of a new one, taking eco-effectiveness into account. Here are the six "Rs":

- *Re-think* the products and their use.
- *Reduce* use of energy and materials.
- *Replace* dangerous substances
- *Recycle*, using recycled materials as well as those that are recyclable and those designed to be recycled.
- *Reuse* parts and components.
- *Repair*, design in such a way that enables repairs and a product's longevity.

## The eco-design eco-criteria

Twelve years ago, in the year 2000, the eco-design manual from Sociedad Pública de Gestión Ambiental IHOBE (Public Society for Environmental Management of the Basque government; *Manual práctico de ecodiseño. Operativa de implantación en siete pasos* (Practical handbook for eco-design; Introduction in seven steps) was born. It was the result of the whole practical process of lending and socializing the Basque industrial experience in connection with international demands for a design that answers the environmental challenges of our times. The handbook, available in an updated version, includes these words of Hartmut Stiller, an expert from the Wuppertal Institute: "This is not a book to put on your shelf, but an easy to understand handbook developed to be used by small and medium companies. Using the example of a cafeteria,

IHOBE explains in seven stages how to work with eco-design and shows how even such a well-known product has great potential to improve its eco-efficiency".

Starting with this series of seven steps, El Tinter created another to guarantee eco-design in light of ISO 14026 ruling. In this case, as would be expected, the example of the cafeteria was replaced by the printing process. Here are the steps that have been updated according to the ISO 14026 ruling:

**1. The client**

Provide the client with information regarding the importance of the product being designed with eco-design criteria. Assess if the client is already aware in this regard, and if not, involve them in the acceptance of the ecological and sustainable criteria.



This is the first and most important step, as it is when decisions are made. It is also at this moment that prudent printing or printing according to demand should be talked about. These two measures can significantly reduce the processes' environmental impact if carried out with reasonable criteria.

**2. The paper and the format**

Centre most of the design effort in promoting maximum use and reducing waste. Before presenting the technical criteria to the client, it's important to have fully investigated the use of the final product, its durability and its intended target. And then propose the type of paper suitable for each case (type, weight, format, etc.).

When designing the proposals, standard paper formats should be used (A5, A4, A3, A2, originating from the 65x90cm format and subdivisions of the 70x100cm format). The use of paper with eco-labels and ecological insignias must be encouraged; recycled (offset recycled, coated recycled or mixed quality papers) and virgin fibres from sustainable managed forests (FSC). By decreasing the margins in the layout to 1.5cm instead of 2.5cm one in every six pages can be saved. Any waste obtained during printing should be reused to generate new products, gifts for the clients or for internal reuse for tests. Using recto-verso (double sided) printing during trials, corrections, etc. This means the photocopier saves 10% of its electric use.

Publishers can adjust the machinery to the paper used in each production according to the type of book and its format, reducing waste. Reusing any surplus paper for new products avoids paper getting tied up. This aspect of eco-design is particularly important in large publishing houses.

### 3. Applying the colours

The discussion over the amount of ink used and its environmental impact is resolved the same way as with paper: each product has its specific needs and the decision to use one, two or four colours is not the same for all products. 100%, very dark backdrops and frames use more ink. Using backdrops and frames at 75 or 50% saves ink.

Reducing the amount of ink is an important issue. That is why when printing in four colours, it is worth using a plate imposition system with stochastic screening, as this minimizes the number of dots of ink that are later printed and, therefore, reduces the amount of ink used.



It is also advisable to use inks that have the least impact on the environment, at present these are inks made with vegetable oil.

### 4. Replace paper for bytes

Often, when talking about the de-materialization involved in replacing paper format with an electronic format, we forget that producing the device, its support and the recycling as electrical and electronic device waste, has an impact on the environment that isn't always taken into account. The electronic dynamics also involve technological replacement in ever shorter periods of time, CDs and DVDS are now in regression, replaced by devices like the USB pen drives, PDF formats, or FTP servers all of which allow for easy mobility therefore saving on delivery costs, etc.

### 5. Using die cuts

Die cutting is a process where any paper or cardboard can be cut or marked for cutting so as to be presented in a new format. Even though by using die cutting a considerable amount of paper may not be used, if it is done in the right way our printed material can be given a second life (making boxes for table top objects, decorative objects, calendars, etc). It allows for the partial or total reuse of an object and at the same time causes awareness regarding reuse.

One example is to use die cutting to use up leftover card from book covers to make bookmarks, or to design the formats of magazines using systems that eliminate cutting, folding in such a way that allows for postage without envelopes and then using stickers to attach delivery addresses.

Even though die cutting doesn't affect the publishing world in a great way, it does make up one of the arts with most possibilities in the world of eco-design. The design of the die cut, that needs to be worked in with the other phases of the product's design, must be combined with other aspects like weight or even, with an eye on the world of biology, for example: make

a fold that means our product weighs less, is easier to distribute and takes up less space. That is precisely what nature has done with the wings of certain animals.

**6. Product manipulation**
Fundamental is the need to reduce the use of binding adhesives and the manipulation of projects, as these often contain toxic substances and in many cases can be substituted by small pocket die cuts, folders or covers included in the publication. It is compulsory to use folding, stapling and stitching, and in that order, before using adhesives. Varnish should be used over lamination and always assess with the client the use of protective varnishes, whenever the use of the product allows it (books and magazines).



**7. Distribution and logistics**
Large advertising packages must be avoided (like plasticized pallets) instead use reusable or recyclable boxes made from one material (like recycled cardboard) and recycled paper wrappings. It's also important to specify the material with the corresponding triangle and number 20, 21 or 22 and the initials PAP (paper) at the bottom.

**8. Waste management**
Eco-design should enable the product's management as waste so that the appropriate selective collection is used in each case (private entity or company). Products with just one material, no adhesives, plastic, staples etc. guarantee, in most cases 100% recycling.

**9. Information for purchasers**
Always graphically incorporate environmental information about the product for the public, whether as an environmental backpack or with the slight reference to the products final aim, making mention of the greenhouse effect gas emissions. The product must provide the consumers with information regarding its reuse and in the last instance, the correct selective disposal of the product.

## Eco-design certification

Certification in eco-design offers organizations the chance to get ahead in fulfilment of the current law, to access more demanding markets, to improve the image of the product and the company, to improve the fulfilment of demands by the interested parties (administration, clients, etc) in a more sustainable economy, to stand out from the competition, to reduce production costs, to promote innovative products, to put themselves in a privileged position for future methods of green purchasing, and to increase the quality of the product or service.



In 2003, regulation UNE 150301 was approved, regarding environmental management in the design and development process, the first certifiable regulation in this area. This regulation includes the requirements for an environmental management system in eco-design, compatible with other systems like ISO 9001 and ISO 14001.

In 2011, nearly three years after starting the work within the International Standardization Organization, international eco-design regulation ISO 14006 was published, regarding environmental management systems and guidelines to incorporate eco-design. The document, which received international acceptance, was based on regulation UNE 150301.

Design studios and workshops should be very interested in this, as implementing this rule adjusts to the purpose and scale of the company, with no need to implement more complex environmental management systems. To adopt it and benefit from it, there is no need to be previously certified in ISO 14001 or EMAS, but for those who do hold these certificates, it will be a whole lot easier to implement this regulation and obtain the eco-design certification as they have many points in common.

**Differences between the eco-label and eco-design**

| The Eco-label | Eco-design |
|---|---|
| The eco-label is evidence that a product meets certain pre-established environmental criteria, and guarantees that all different products with this label have the same features. | It gives the organization the freedom to choose, according to the properties of their product or services, where they will incorporate environmental improvements into the design. |
| It ensures fulfilment of set requirements according to specifications; rules that do not change over time. | It is based on continual improvement, in other words, it guarantees the systematic introduction of improvements for later designs or new products, and therefore, their evolution when it comes to sustainability. |
| It entails an improvement of product image. | It means an improvement in product image as well as the company's management system. |

## Design to recycle

The design to recycle method incorporates recycling criteria into the product's design, with the aim of obtaining recycled and recyclable products. The environmental aspect is another requirement of the product that is included with other considerations like cost, security, easiness of manufacture, usefulness, etc.

Considering this aspect does not affect the rest of the product's properties and combines price and environmental improvement with the aim of producing items of a reduced global environmental impact associated with its whole life cycle and at competitive rates.



## The recycled product and the recyclable product

Gary Anderson, a student at the Southern California University, Los Angeles, designed the recycling insignia, based on the unending single sided looped surface thought up a century before by visionary scientist August Ferdinand Möbius: known as the "Möbius Triangle". He took part in a competition held to celebrate the first Earth Day on the 22nd of April 1970.

Each arrow represents one of the three processes, use, reuse and recycle. Often however, recycled is confused with recyclable. If the material is partly recycled, the products must indicate the percentage. Paper can be recycled and therefore is recyclable.

Recycled products are those made using recycled materials, or components from products that are now not in use. Recyclable products are those made to be recycled at the end of their useful life, in other words, they are made with compatible single materials, avoiding toxic and hazardous substances and identifying hard to recognize materials using codes, they are of modular manufacturing, easy to dismantle, etc.

## Steps a company must follow to incorporate ecodesign criteria

1. *Company commitment*: Management must approve commitment to the project. Inform the rest of the organization.
2. *Define the team according to the type of company and its possibilities*: Design, program and carry out the different stages of the design process for the products recycling. Assess the need for each purchase and the environmental impact it entails.
3. *General assessment of the product:* Assess the following aspects of the product: Product information (detailed description: purpose, components, etc), key design and production aspects, materials used in manufacturing and transportation, resources employed during its use, emissions generated and average life, company, resources and capabilities: installations, resources, environmental policy, team, etc. Pressures and potential to change the product: environmental aspects, new materials, new technologies, and client and market demand. Market: purpose, quality, price etc. Competition: identify competitive products on the market with good environmental behaviour.
4. *Assessment of the product's environmental impact and proposal for environmental improvements*: Carry out the product's life cycle assessment: general view of the more important environmental impacts the product will have during the different stages of its life cycle. Identify the priorities and environmental improvements that must be taken into account during the design process.
5. *Implementation of selected environmental improvements:* Prioritize the selected improvements.
6. *Assessment and monitoring*: assess the effect of the incorporated environmental improvements. Establish a momentum and tools for continual environmental improvement.

## An example of waste

This example, presented by Salesianos de Sarrià professors Ángel Fernández and José Manuel Martínez in the 2010 Parliament Eco-edition's Parliamentary commission finishing workshop, reflects how in one print run the format can generate a loss or waste of either 29,61% of the total paper, or 15%. This loss is both an economical and ecological one because it creates unnecessary waste. Taking into account, then, the size of the paper chosen provides a very useful indication for the products design.

300 page publication with a print run of 5000 copies; estimated waste is 5%.

Fibre direction; parallel to the spine.

From each 100 x 70 sheet, we get 32 pages (16 sheets on both sides).

Therefore 47,250 sheets (90 g/m$^2$) are needed, each one weighing 63g, so a total of 2,976.75 kg of paper.

The papers printing surface is 6,732 m$^2$, but only 3.101 are used, representing 26% of the total.

In this example, 883kg of waste paper is generated, so 29.61% of the paper purchased. If we were to reduce to 10 and 5 cm respectively, each side of the initial paper (90 x 65 cm), 467 kg of waste would be generated: just 15% of the total.

Therefore, to reduce paper waste to the maximum, the ideal size of the final book is 16.5 x 23.5 cm (cut and bound).

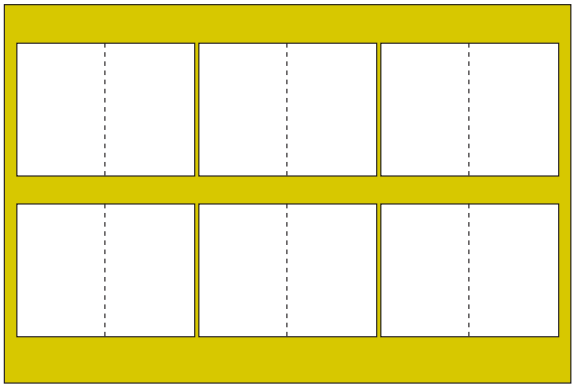
## Paper formats

Not all paper is made in the same format. Before starting a project, it is essential to check what formats are available at the printers. The aim is to chose the most suitable paper format with the aim of saving as much as possible and generating the least waste. If it is an uncommon format, it may waste a lot of paper as seen in the example mentioned above. Even though left over paper, after passing through the guillotine, will be recycled, it only takes a few adjustments to the dimensions of the designed object to make it more efficient.

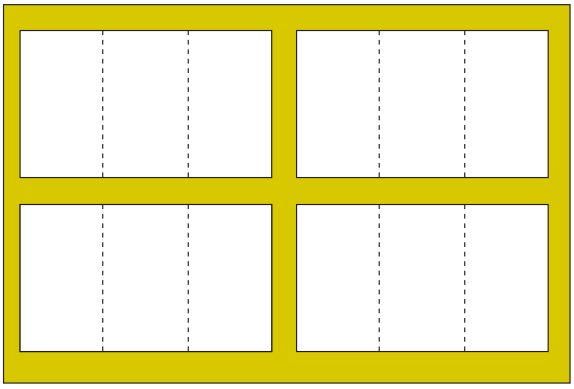
The European standard formats are:

450 × 640 mm
520 × 700 mm
630 × 880 mm
650 × 900 mm
700 × 1,000 mm

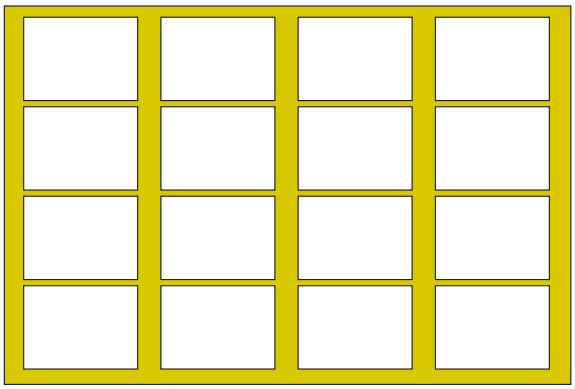




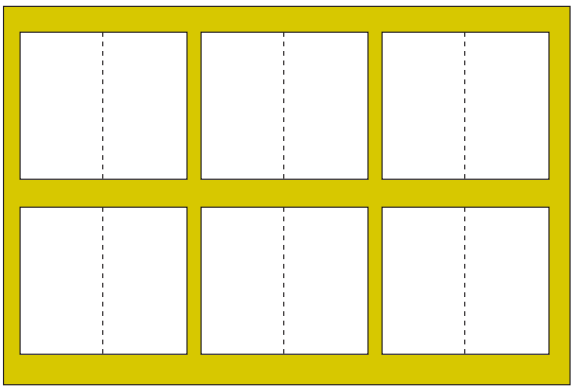
Catalog four sections (4) 10.5 x 21 cm



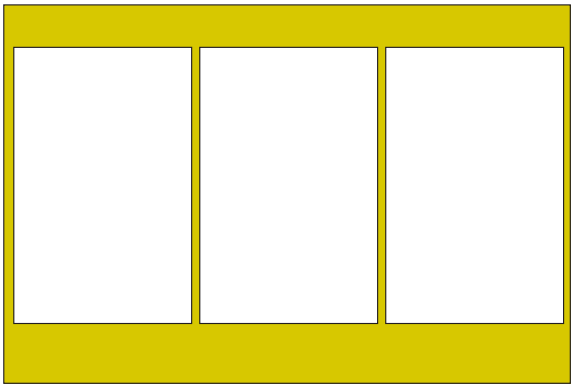
Catalog four sections (4) 10.5 x 21 cm



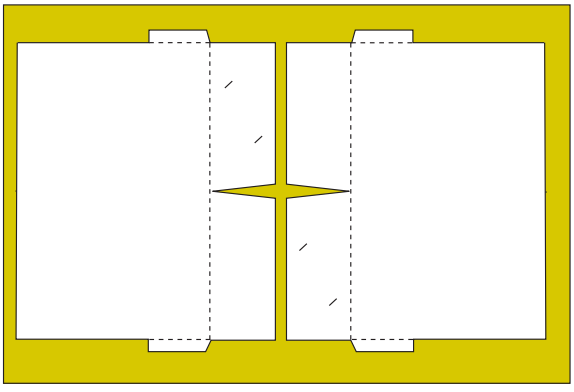
Postcards (16) 10.5 x 14.8 cm



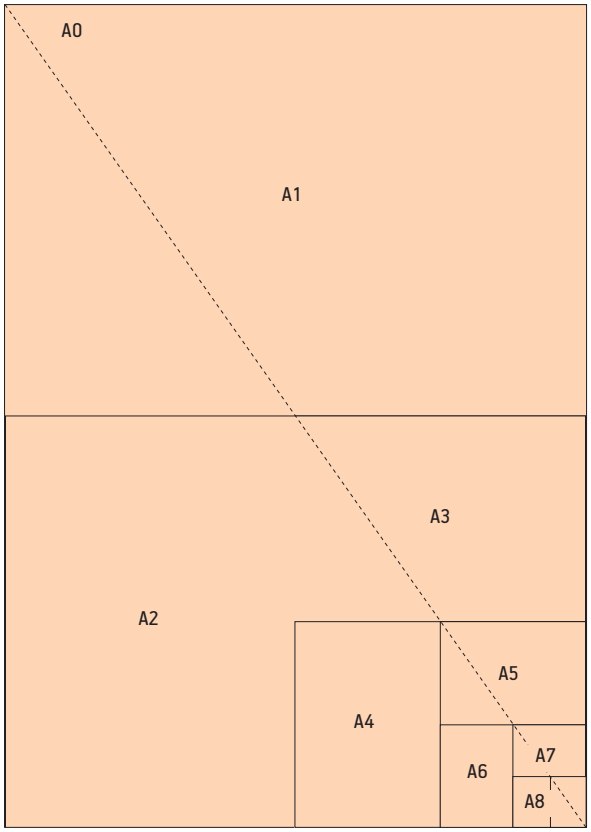
Catalog two sections (6) 10.5 x 22.9 cm



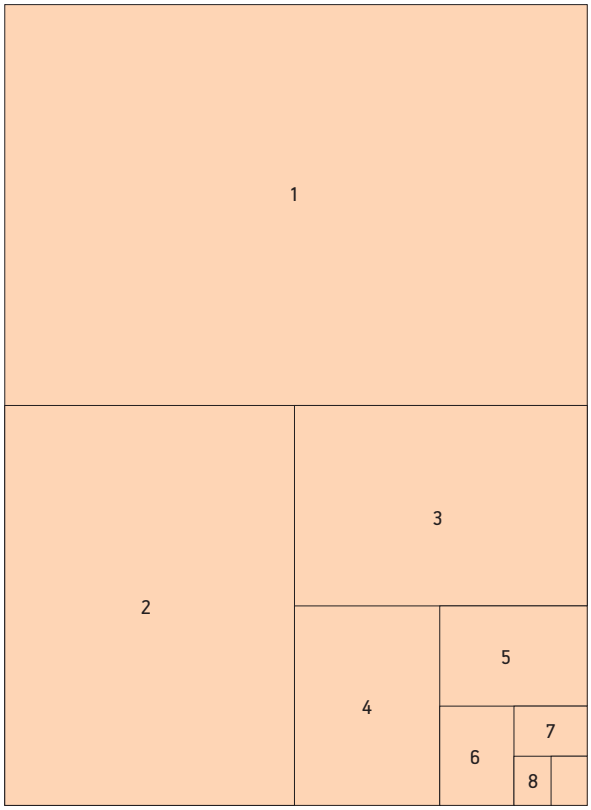
Posters (3) 29.7 x 42 cm



Folders with pockets (2) 21 x 29.7 cm




Division of standardized paper (from the A0 format of the standards ISO, 841 × 1,189 mm).




Division of traditional or classic sheet (from the format 320 x 440 mm). 1) sheet; 2) fourth; 3) eighth; 4) sixteenth; 5) thirty twelfth; 6) sixty fourth.

ISO 216 ruling from 1975 establishes the basic standardization of basic paper and specifies the standard formats for paper. It is based on three series of dimensions. The A series is for printing and correspondence; B series mainly for posters and C series for envelopes. UNE 1011 regulation specifies the same measurements.

| Series A (in mm) | | Series B (in mm) | Series C (in mm) |
|---|---|---|---|
| A0 | 841 x 1,189 = 1 $m^2$ | B0 1,000 x 1,414 | C0 917 x 1,297 |
| A1 | 594 x 841 = 1/2 $m^2$ | B1 707 x 1,000 | C1 648 x 917 |
| A2 | 420 x 594 = 1/4 $m^2$ | B2 500 x 707 | C2 458 x 648 |
| A3 | 297 x 420 = 1/8 $m^2$ | B3 353 x 500 | C3 324 x 458 |
| A4 | 210 x 297 = 1/16 $m^2$ | B4 250 x 353 | C4 229 x 324 |
| A5 | 148 x 210 = 1/32 $m^2$ | B5 176 x 250 | C5 162 x 229 |
| A6 | 105 x 148 = 1/64 $m^2$ | B6 125 x 176 | C6 114 x 162 |
| A7 | 74 x 105 = 1/128 $m^2$ | B7 88 x 125 | C7 81 x 114 |
| A8 | 52 x 74 | B8 62 x 88 | C8 57 x 81 |
| A9 | 37 x 52 | B9 44 x 62 | C9 40 x 57 |
| A10 | 26 x 37 | B10 31 x 44 | C10 28 x 40 |

Source: *Manual d'estil. La redacció i l'edició de textos.* Josep M. Mestres, Joan Costa, Mireia Oliva and Ricard Fité. Vic: Eumo. 1995.

# 6. Printing



The graphic art industry production process consists of three stages: pre-printing, printing and post-printing or finishing stage:

1. *Pre-printing* includes the design, lay out, editing, preparation of print format and plate setting. Nowadays films have been eliminated and the final process to obtain the printing plate is done directly from computer to plate (CtP) saving the phases in between.
2. *Printing* includes different printing techniques, like offset, digital offset and digital as well as typographical, flexographic, rotogravure and screen-print.
3. *The finishes* are the binding, cutting, folding, raising, stitching, milling, gluing and if in some cases stamping (adding metalizing agents).

All these procedures generate atmospheric emissions, liquid waste and solid waste that must be eliminated, minimized and in any case properly recycled. There is no need to say that the main risk is that of professional exposure, secondly to the environment whilst not forgetting the risk to the end user.

## Reduction of developing waste

The pre-printing process CtP (computer to plate) consists of taking a digital image and producing an offset plate straight from the computer. CtP pre-printing machines or plate setters separate the colour directly on an offset plate using laser beams. This way there is no need to use film or plate exposure, which decreases the time, the costs and the environmental impact of pre-printing, as no waste is created.

The goal of Barcelona company Gràfiques Ortells SL's plan of action and replacement was to reduce by 75% the waste in the pre-printing process with CtP. But this goal was exceeded, as the percentage reached between May and September 2011 was of 90%.

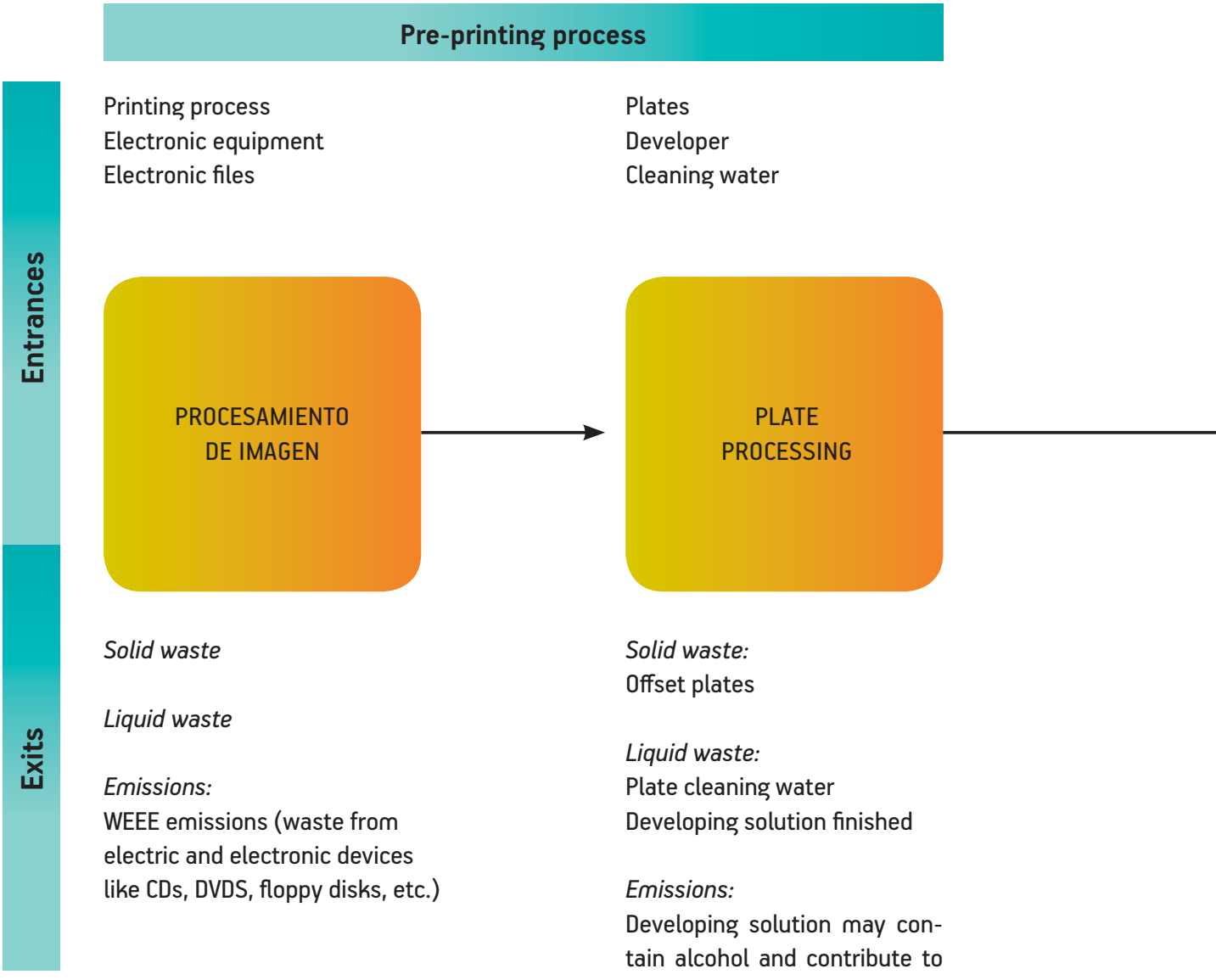


With the old technology (Agfa Galileo VS with a Lithostar LP-82 Ultra processor) the plates had to be developed using chemicals and waste was generated that was classified by the European Waste Catalogue as CER 090102 (water based developing solutions for printing plates).

The system chosen to substitute the old one is CtP Agfa Avalon N8 60S, with Amigo TS plates. The most notable results are the reduction in generated waste by 90%, savings in raw materials, saving in machinery maintenance time, a reduction in the use of water, saving in rubber and energy efficient improvements. All the replacement experience has been summarized in a document that assesses the experience.

## Diagrams of the offset printing process

The waste flows associated with the printing process, both liquid, solid and gas emissions depend on the different types of printing (offset, topographical, flexographic, vacuum engraving, screen printing and digital). Here we replicate offset, but the post printing process and finishing are the same for all the systems.



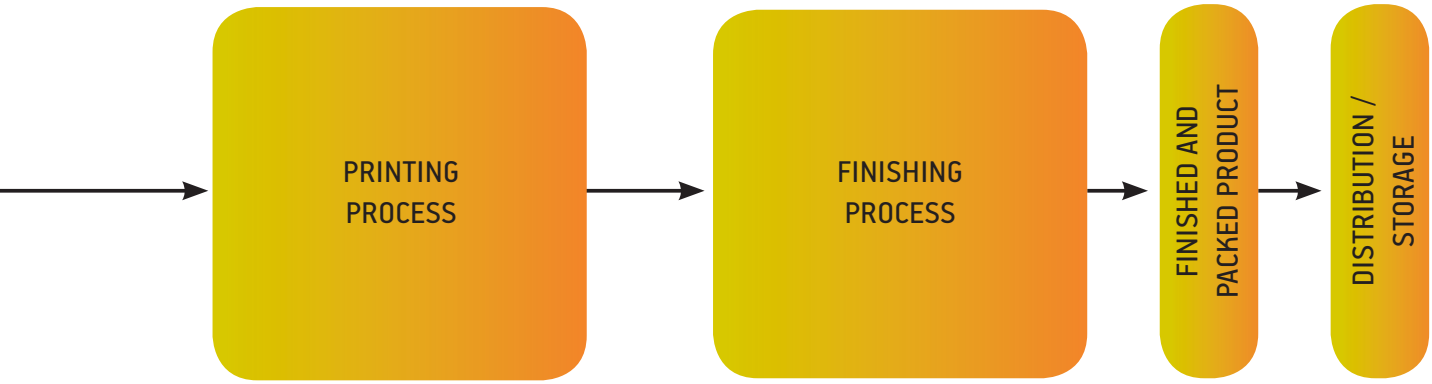

Source: *Prevenció de la contaminació al sector d'arts gràfiques*. Barcelona: Departament de Medi Ambient i Habitatge de la Generalitat de Catalunya, 2003 (Manuals d'Ecogestió; 12).

**Printing process**

Paper
Wetting agent
Ink
Cleaning solutions
Rags

**Finishing process**

Paper, plastic
Adhesives and glues
Packaging




*Solid waste:*
Paper off cuts from tests and printing
Rags that contain solvent inks
Plastic and metal containers

*Liquid waste:*
Solutions finished
Residual ink
Solvents used to clean the press and remove excess ink

*Emissions:*
The volatile wetting solution can contribute to gas emissions.
Solvent based inks and cleaning solutions contribute to gas emissions.

*Solid waste:*
Paper off cuts
Paper, cardboard, plastic, wood, laminating film or any packaging product

*Liquid waste:*
Leftover glue

*Emissions:*
Possible atmospheric emissions

## Stochastic screening

Offset was discovered at the beginning of the 20th century by North American printer Ira Ruble, from New Jersey, and it took over, more because of its speed than its quality (the rotary movement of offset printers allows for faster speeds than the alternative movements of lithographic and typographic printers) and because of its competitive prices.

Offset is a printing process that uses flat plates that use oil based inks and a wet solution on one side during the printing process. They are not opaque inks; the colours build up, without covering each other.



Screening consists on converting the images or original tones of the images into small dots that, conveniently organized, simulate the different colour degrees. The human eye combines those small dots and creates an optical illusion of continual colour, or a photographic appearance.

AM screening (modulated amplitude), called conventional, consists of placing the dots according to a fixed pattern of a grid, in which the dots are placed in an equidistant manner forming straight angles between themselves; to achieve more intense or lighter tones, the size of each dot is altered. The bigger the dot the more intense the colour reproduced.

To create the composition of the screening of the four colours, the dots vary in size, forming in this way the colour gradation scale.

The intrinsic features of this type of screening involve alterations and non desired effects in the reproduction of the original moiré (from the French meaning iridescent), the alteration of the printed image caused by the interference of the amplitude of the AM screening dots with the original image's pattern.

FM screening (modulated frequency) called stochastic, uses dots that are always the same size. They are much smaller than the AM screening dots. To achieve different tonalities, stochastic screening modifies the frequency with which these dots appear and the placement of the dots doesn't follow any pre-established pattern, but what seems to be a random layout, with no direction. In fact, it is carried out by distribution algorithms that simulate a random layout. The better the set of algorithms applied, the better the resulting screen.

This method counters the appearance of moiré and the problem of the appearance of the rosette formed by four angles of average tones in the colour reproduction process, which is cancelled out. More dots in the same space make the colour more intense.

The use of stochastic screening is fairly recent, especially in commercial printing. Digital printing inkjet printers also use stochastic screening.

These screens, by their very nature, do not take the form of dots, screening angle or pitch. In these screens we need to talk of "resolution", that tends to coincide with the real resolution (that's to say: maximum in printed dots) of the device. Therefore, a plate setter with 2,400 stochastic dpp (dot per pixel) really has that screening resolution. This is the case, unless you want to use more than one printed dot for each screening dot (2,400 dpp divided into 2 are 1,200 dpp).

Stochastic screening emerged at the end of the eighties, even though there was reticence in adopting this technology by the printers, as transferring the microdots from the film to the plates was a real challenge. Many microdots were lost in the process. The arrival of CtP and the elimination of film have given this technology wings, which represents real added value.



There are two types of stochastic screening: first rate and second rate. With first-rate screens, only the space between the dots varies to reproduce the original tones. With second-rate screenings, the size and the space between the dots are modified generating more overcrowding of dots.

### Hybrid Screening

Hybrid screening mixes AM screening with stochastic screening, depending on the type of image. The algorithm (set of rules to solve a problem in a limited number of steps) generates AM or FM screening, depending on the image's detail; for example in flat tonal areas that are prone to generate a granulated effect, the algorithm uses AM screening, in other types of hybrid screening it would use FM between 0 and 10% and between 90 and 100% while between 10 and 90% the algorithm would use AM screening. With hybrid screening the aim is to obtain the best reproduction in each tonal shot. Other screening algorithms use AM with medium tonal features and automatically respond to high lights and shadows by changing over to stochastic.

## Digital printing

According to Albert Cuesta on the 16th of June 2011, in an *Ara* newspaper article, during 2010 51.8 billion pages were printed worldwide. Less than 9% of these printed pages were in a business and home setting. Most of them, some 47.2 billion, came out of printers and graphic art workshops: half in the form of publications and the rest as promotional material, packaging, posters and photographs among others.

95% of these pages were printed using conventional procedures: offset and serigraphy mainly. Even though only 5% were printed digitally, using xerography (from the Greek Xeros meaning dry), the total value of that 5% represents 35% of the total.

Digital printing is a process that consists of printing directly from a digital file onto paper, using different methods, the most common being ink jet in a cartridge printer and toner in a laser printer.

Digital printing includes toner printers (like laser printers that use heat to stick dry pigments to the paper) and ink jet systems that vaporize water and ink made with solvents right onto the paper or other backgrounds for printing. An advantage of digital printing is that it does not emit any volatile organic compounds (VOCs). And ink jet printing has even eliminated gas evaporation. Other advantages are that it does not need exhaustive cleaning (along with saving in time and solvents) and that start up does not waste resources.



Digital printing allows for very short or very long print runs without changing the plates or stopping the machines. Different surfaces can be printed on, rigid or flexible. And on top of this, computerized management allows for the information to be personalized.

In fact, this technology is not new or strange, as it hasn't changed since the eighties: drops of ink are heated up so as to be projected onto paper or another background. What has improved is the quality and speed of the applications both in industrial and domestic settings.

For companies that promote this technology, the business is in the ink. During their life, industrial printers can use ink up to three or even four times the value of the machine's initial purchase price.

When it comes to domestic printers, the proportion is even more spectacular taking into account the price of these printers. For this reason, refill value is astronomical. This allows for business to start from the first ink refill.

95% of the four million HP printers sold in Spain use original HP ink. A litre of ink for the 364 model costs (price from September 2012) more than 1000 Euros (served in 77 cartridges). Comparing these prices to the price of offset ink printing is shocking. A litre of synthetic ink can cost from 7 to 9.2 Euros or if it's a vegetable oil ink from 9 to 11 Euros.

Digital printing ink is provided in one-use cartridges that cannot be recycled (Eco-toner) nor selectively collected and that are sold in blister packs.

A blister is a transparent plastic package with a cavity that holds the product so it can be seen and at the same time protected from damage dur-

ing handling and transport. Blisters also use a sheet of card that serves as backdrop for the product that is often used to insert messages for the user: make of the product, logo, and instructions for use, safety precautions, etc. Everything apart from identifying the materials it is made from, obviously plastic and card, and what to do with it once it's open.

Labels do not include the amount of ink in the cartridge in millilitres (ml) or its composition anymore. This information is replaced by the estimated number of pages that can be printed with the cartridge, using a standard parameter of covering 5% of a DIN-A4 (a sheet measuring 21 x 29,7cm) with ink.



The price of ink in public photocopying machines is included in the maintenance cost, therefore is not available information. But the expensive price of the cartridges for home printers has meant that many people now take a lot of their printing work to these shops. USB sticks ease the process of transfer to the copier: a lower cost printing service.

The printing performance of ink jet printers is regulated by ISO/IEC 24711. The printing performance of colour or black laser printers is regulated by the ISO/IE 19752 and the ISO/IEC 19798 (hp.com/go/learnaboutsupplies).

In summary, the environmental impact of home printers is very high, especially due to their reduced usage. The price of the ink becomes the environmental brake in containing their use.

There are cartridges that can be refilled with ink from other brands that offer a lower price.

Original consumables have a higher performance: up to 34%, according to the manufacturers speaking in defence of their consumables. For twenty years now, manufacturers have released hundreds of different inks for each of which they have tried up to a thousand different ingredient combinations, with recipes including colouring, preservatives, binders, wetting agents, and additives to avoid the paper curling and to ensure that the last drops of ink from each cartridge maintain the same printing quality as the first.

A great part of cartridge waste goes to the rubbish: the refuse container. All this perverse business, associated with planned obsolescence (a design with a hidden but programmed expiry date) and the common practice of use and dispose, makes the purchase price of printers absurd. Maybe these prices explain the total final value of this 5% of total printing that represent 35% of the whole pie.

Royal decree 208/2005 came into force in 2005, about electric and electronic device waste. Some of this toner waste: those from printing cartridges

are no longer considered dangerous (080318: Printing toner waste is distinct from those specified in the non special 080317 code). However, there is still printing toner waste (080.317) that contains hazardous substances (special).

It is advisable to keep a track of the amount of waste handed over so as to keep a correct record of the amount of waste generated by a family, or in a professional or business environment.

On the other hand, home printers have now increased their usability: they print, scan and photocopy, some can send and receive faxes, and they often have Internet access via WIFI or USB cable.



Toner, also called dry ink due to a functional analogy with the ink, is a fine dust that is deposited on the paper to be printed on using an electrostatic attraction or magneto-graphic printing. Once the pigment is in place it is bound to the paper with pressure and heat.

This polymer dust comes from the synthetic chemical from petrol that is fused by heat in the digital printing process. The dust is extremely fine and stays suspended in the air. Toner has a potential risk for people's health as it cannot be recycled. Paper with toner is hard to allocate when obtaining recycled paper. Toner also contains heavy metals like lead (pb) chromium (Cr), iron (Fe), zinc (Zn), cadmium (Cd) and copper (Cu) in unknown quantities.

Each year more than 200.000 tons of toners are used (data from 2006). In the International Eco-products fair held in Japan in 2007, a biomass toner was presented, made with vegetable resins. Company Ricoh committed to lead the process, of which presently, very little is known. There are also toners made with soya oil.

The newest HP printing systems consume less plastic and less energy without compromising their print quality. Ink cartridges and monochrome toners are showing environmental improvement, as the spherical properties and the uniform size of the particulates of the new toner allow for a more efficient printing while using less resources and with a lower demand on the energy supply than previous generations of printers.

The height of cynicism is that shown by company Ábitat when they offer an "ecological toner". Their secret is in the manufacturing process of the ÄbitatR toner cartridges: partly from plastic cases of empty cartridges, with the rest of the components being "completely original": coming from the main brands in the sector.

Industrial digital printing now uses liquid inks that almost equal the quality of the traditional offset printing for images used when publishing books. This opens the door to "books a la carte". Amazon, the Internet book distributer,

offers books from their publishing pool which are printed to order, both in colour and black and white. This is one of the results of the transformation from analogue to digital. Low print run orders for books, rare editions, and author's collections are constantly growing, opening up new possibilities to authors, publishers and booksellers.

## Waterless printing

This process, that is applied to offset lithography to print all the materials used in traditional offset lithography, does not need water or wetting agents. It is a mechanical process based on the temperature and elimination of water and wetting agents that contain isopropyl alcohol or substitutes. Therefore in this way the use of water is greatly reduced as well as the generation of volatile organic compounds (VOCs), and the waste of paper. On top of this there is up to 100% increase in productivity.



The Waterless Printing Association was formed in 1993 and has its headquarters in Woodstock, Illinois (USA) and it promotes waterless printing technology. But there are two problems when setting it up: the difficulty when providing special plates that need to be used in this process and the lack of training for workers. This technology is advancing in Japan. As well as saving water it eliminates the use of wetting agents.

In Catalonia, Gráficas Varias, in Sant Sadurní d'Anoia, an EMAS company, uses a waterless printing technique. For more information go to: www.clubemas.cat/clubemas/RQG/RQA_07.pdf.

## The finishes

The set of techniques used to finish the book publishing process have a significant environmental impact. These cannot be ruled out or forgotten, as the inside of a book, despite being the main part of the book, is not the whole book.

### Lamination

The main aim of this finish is protection. Cold lamination is more common and cheaper. Hot lamination machinery is expensive due to its high energy use.

Here are some of the most used plastics that are applied cold:

- **Polypropylene [PP 5]:** A plastic that withstands further finishes well.
- **Polyethylene [HDPE 2, LDPE 4]:** One of the types of plastic allowed in children's products.

- **Acetate:** Has low resistance and breaks easily, but is the only one that can be used on both sides of the printed sheet.

Here are the criteria to take into account when laminating:
- Paper weight (at least 125 g/m² recommended).
- It must be smooth (can be matt or shiny)
- Lamination may also be combined with varnishing.

**Varnishing**



A transparent covering (considered to be ink) that is used to embellish the product. It is less protective than plastic but is more respectful with the paper's properties.

In the paper recycling process, varnish can be removed at the same time as the inks.

The most used varnishes are:
- **Fatty:** They use oils, mineral and vegetable resins and petrol derivatives.
- **Acrylic:** water based.
- **UVI:** Contain photo-initiator and polymerize instantly when they receive UV radiation. They are recommended for *off-line* varnishing.

***Criteria to take into account when varnishing***
- **Paper weight** (at least 80 g/m² are advisable).
- **Drying** will need time (one to two hours, apart from UVI varnish that dries instantly).

***Stamping and embossing, that have the aim of giving a strictly visual look***
- **Stamping:** a selenium mould pressures a stamping sheet that through pressure and heat sticks to the product.
- **Embossing:** Deforming the product from behind. There is no need for a film. This technique can be combined with stamping.
- **Screen printing and UVI reserves**: An acrylic protective varnish that covers all or part of the cover with the aim of enhancing it.
- **Heat embossing:** A false embossing because there is no mould; special inks are used whose particulates, when heated increase in size. Very shiny.
- **Minting or die cutting:** A mould is made with metallic strips with tips (that cut) and/or rounded ends (that make indentations) and/or perforating strips.

**Binding**

It's important to know the weight so as to predict the folds and their types (window, zigzag, accordion).

- **With staples:** Binding with metallic staples is a good option for magazines and brochures of up to sixty or eighty pages. It is done by cross folding the sheet that comes out of the machine and overlapping some folds within the others. The magazine is opened in the middle and stapled, normally twice. Then it is closed and guillotined on three sides. Even though it uses metallic staples, it must be said that it is the most convenient system for formats with few pages.
- **Perfect binding:** great for paperbacks. The cover is normally card, thicker than the paper inside. The pages are bound in folds that are cross-folded and placed one on top of each other until the book is complete. They are then separated and cut down the spine of the future book to allow the glue to penetrate and for the sheets to stick to each other (5mm of margin are lost). After this the cover is added, this has already been split open and is then stuck to the spine, the same as with staple binding, the book now has to be guillotined on three sides.
- **Sewn paperback:** The same initial binding procedure is followed as above. The interior pages are cross-folded. Then placed each one in the different fold and sewn with vegetable thread. Once the entire book is sewn, (it does not have to be cut because the folds are already fixed together) the glue is added to stick the cover that has already been split to enable the fold. This is a stronger, more durable type of binding, and uses less glue than the perfect binding.
- **Hard back:** Is the most elegant and durable binding, as it provides the most protection for the book. The process is the same as for the stitched binding, but when it comes to covering the book it is not done with card, but with a piece of paperboard that has previously been lined with the printed paper cover. The cover has its own process, it is covered with paper, normally printed on, and pages called flyleaves are prepared, with which the cover is stuck to the inside.



***Binding waste***

To optimize the use of paper and reduce waste caused by binding, commercial formats must be taken into account, as well as the printable surface, which means, taking into account the pleat (1cm), the counter pleat (1cm), the control strip (1cm) and the edges on each side (0,5cm) to avoid dirtying the rollers.

It is also convenient to consider the kind of binding that will be done to know how much space to leave for the spine (5mm).

Bear in mind that the three most normal types of binding are paperback, flap and hardback. Each one has a different impact depending basically on the weight of the paper and the card. The impact of this weight must be considered. Within these binding systems, we find the metallic staples and vegetable thread, the second being the most advisable.

# 7. Distribution



Once printed, bound and finishing touches have been applied the book (or magazine) can start its life. The gap between manufacturer and reader is covered by distribution and a physical or electronic point of sale. It needs to be wrapped for protection and transport. Worthy of serious consideration is the fact that all this ecological effort will be worthless if the print runs have not been adjusted to the demand and items are returned to the distributor unsold.

## Shrink Wrapping

To enable the distribution of a book, magazine, or any other publication, shrink wrapping can be used, it consists of a sealed plastic film wrap designed to protect or even replace the envelope in the case of magazines or documents but that can also be used with books. It also enables the delivery of parcels with different items (a magazine, a supplement, promotional material, etc.).

There are two types of shrink wrapping: simple polywrapping or polybagging and shrink wrapping that is done with heat.

The material used can be cellophane, which is a paper derivative (renewable), or plastic which is a petroleum derivative (non renewable). Cellophane is a natural polymer that comes from cellulose. It is a very fine, transparent film that is flexible and resistant to tensile stress, but very easy to cut.

With time, the term cellophane has become generalized and includes various plastic films that are not cellulose based. Presently, cellophane has been replaced by polypropylene (PP 5) and low-density polyethylene (LDPE 4), which is a petroleum derivative and should be differentiated from cellophane made with cellulose fibres (renewable).

Low-density polyethylene (LDPE 4) is a plastic made by ethylene macromolecules that are polymerized at high pressure. As wrapping and packaging it is identified with the number 4. It is a plastic that seems damp to the touch, unlike high-density polyethylene (HDPE 2), that makes a noise when touched and is identified with the number 2.

Polypropylene (PPF) is a thermoplastic polymer, partly crystalline, that can be obtained from polymerizing propene. It belongs to the polyolefin group and as wrapping and packaging we identify it with the number 5 in a recycling triangle with the initials PP underneath.

This triangle is formed with three arrows, called "the Möbius triangle", as we said before, in memory of Augusto Ferdinand Möbius (1790-1868), the designer of the two faced strip that these arrows are based on. In the centre is the number, and underneath, the abbreviation of the material that the product in question is made from.

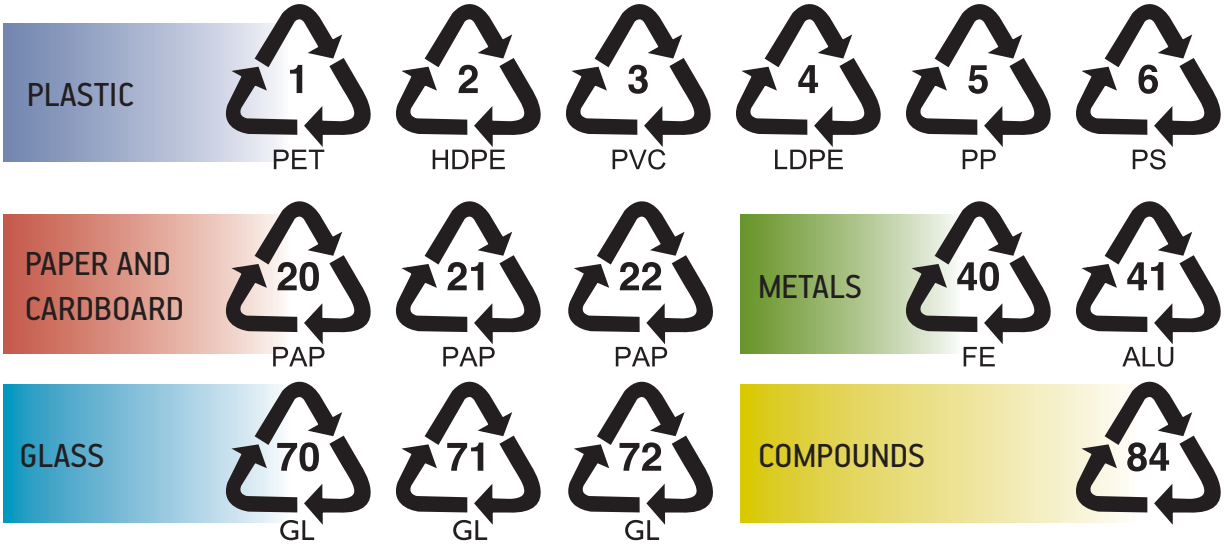


## Transport boxes

One use cardboard boxes tend to be made of recycled corrugated cardboard. To guarantee that it is recycled cardboard, one must know for certain if it is or not. It is important to not confuse "recycled" with "recyclable". Evidently, cardboard is recyclable and probably recycled. The "recycled" symbol may include the percentage.

What is important is to not confuse the use of the "recycled" product triangle with the "destined to be easily recycled". In the case of paper and cardboard, the packaging identification system reserved the numbers 20 to 39 (not including compound materials). Number 20 refers to cardboard, 21 to corrugated cardboard and 22 to paper. The whole series, 20-39, has the initials PAP underneath. The triangle system helps to identify the packaging material and is voluntary.

## Packaging material identification systems, voluntary






For plastic, from 1 to 20

| Material | Abbreviation | Num. |
|---|---|---|
| Polyethylene terephthalate | PET | 1 |
| High density polyethylene | HDPE | 2 |
| Polyvinyl chloride | PVC | 3 |
| Low density polyethylene | LDPE | 4 |
| Polypropylene | PP | 5 |
| Polystyrene | PS | 6 |
| Others | | 7 |

For paper and cardboard from 20 to 39

| Material | Abbreviation | Num. |
|---|---|---|
| Corrugated cardboard | PAP | 20 |
| Non-corrugated cardboard | PAP | 21 |
| Paper | PAP | 22 |

For metals from 40 to 49

| Material | Abbreviation | Num. |
|---|---|---|
| Steel | FE | 40 |
| Aluminium | ALU | 41 |

For wooden materials from 50 to 59

| Material | Abbreviation | Num. |
|---|---|---|
| Wood | FOR | 50 |
| Cork | FOR | 51 |

For textiles from 60 to 69

| Material | Abbreviation | Num. |
|---|---|---|
| Cotton | TEX | 60 |
| Jute | TEX | 61 |

For glass from 70 to 79

| Material | Abbreviation | Num. |
|---|---|---|
| Colourless glass | GL | 70 |
| Green glass | GL | 71 |
| Brown glass | GL | 72 |

For composite materials, 84 corresponds to cartons, with an interior aluminium lid

| Material | Abbreviation | Num. |
|---|---|---|
| Paper and cardboard / diverse materials | C / PAP / FE | 80 |
| Paper and cardboard / plastics | C/ | 81 |
| Paper and cardboard / aluminium | C/ | 82 |
| Paper and cardboard / tin | C/ | 83 |
| Paper and cardboard / plastic / aluminium | C/ | 84 |
| Paper and card / plastic / aluminium/ tin | C/ | 85 |
| Plastic / aluminium | C/ | 90 |
| Plastic / tin | C/ | 91 |
| Plastic / various materials | C | 92 |
| Glass / plastic | C/ | 95 |
| Glass / aluminium | C/ | 96 |
| Glass / tin | C/ | 97 |
| Glass / various materials | C/ | 98 |

At times, pallets are used to enable the distribution of publications. A pallet is a frame made out of wood, plastic and/or other materials that are used to move heavy loads, as it facilitates the lifting and handling of a large amount of products with the help small hydraulic cranes and forklifts.

Wooden pallets represent 95% of the total of these bases or frames that include aggregate pallets, as well as plastic and iron pallets. International standards for phytosanitary measures (NIMF-15 and ISPM-15) have enforced, since 2005, an antibacterial treatment on wood that is destined for export to many countries, but not all. Standard NIMF-15 lays out two possible treatments for wood that is to be used for any type of case or packaging: spraying with methyl bromide and thermal treatment. However, the use of methyl bromide was banned in 2010. As a consequence of the Commission's decision on the 18th of September 2008 (2008/753/CE), relating to the exclusion of methyl bromide in annex I of Directive 91/414/CEE of the counsel, and removing authorization from phyosanitary products that contain this substance, from the 18th of March 2010 the use of methyl bromide has been banned in the EU.



## Transport

Transport, in the life cycle assessment, represents between 23.2 and 6.8% of the environmental impact – depending on the category of environmental impact considered (16.4% in the global warming category). The transport included is from the moment the product is finished until the order is received. Electronic books save on this transport, but the telecommunication devices, the servers that are needed to make them available, have a considerable environmental impact. In any case, the complicated network of comings and goings can be reduced with a mobility plan.

Books arrive at bookshops, and those unsold are returned to the publisher's warehouse. These returns tend to increase with the amount of printed titles, 4.3% in 2011. Returns in 2010 were on average 32.5%, and from small book shops up to 41.2%, according to Comercio Interior del Libro (Interior Book Comerce).

Electronic bookstores have now come on to the scene, and improvements in technology now allow us to track these books. Department stores and large supermarkets now also provide a new outlet and specialized book stores have a loyal clientele, who have however, seen their purchasing power dwindle and are no longer able to buy books no matter the cost.

# 8. Use and End of Life

## Use of paper and recycling



When the average use of paper in Spain was 168kg per person a year, 63.9% of the paper was recycled. Then Spain was incorporated into the 70% club, but right at the lower echelon. It should be highlighted though that Spain is above the EU's average for recycling paper, which lies at 60% of used paper.

The club of countries that recycle 70% has members like Switzerland (79%), Norway (78%), Holland (78%), Japan (74%), Germany (73%), United Kingdom (71%), Austria (70%) or Canada (70%). When it comes to the club of countries who use most paper, we are in 24$^{th}$ place. In the top spots for paper use are countries like Luxembourg (488 kg per person a year), Belgium (361kg), Finland (330kg), United States (300kg) or Sweden (268 kg).

In 2010, paper manufacturing in Spain totalled 6,713,300kg, 4,911,200 of which were recycled. And the total use reached 7,707,100kg including imported paper, of which 73% was recycled and 27% of virgin fibres.

**Paper use**

The average use of paper in Spain, according to data from 2005, is 168 kg per person per year.

| | |
|---|---|
| GRAPHIC PAPER **36%** | 63 kg of newspapers, magazines, books, sheets and notepads. |
| PACKAGING **39%** | 68 kg of corrugated cardboard Boxes for food, drinks, electronic devices, toys and pharmaceuticals. |
| PAPER FOR SANITARY/ HYGIENE PURPOSES **7%** | 16 kg of toilet paper, kitchen rolls, tissues, sanitary towels, nappies, napkins and tablecloths. |
| BOARD **7%** | 13 kg of containers for food, preserves, medicines, perfumes, etc. |
| PAPER BAGS **3%** | 2 kg of strong bags for building materials and foods. |
| SPECIAL PAPER **8%** | 14 kg of decorative paper, labels, filters, tickets, etc. |

Source: Datos de la Asociación Española de Fabricantes de Pasta, Papel y Cartón (Aspapel). Elaborados por Jordi Bigues en 2008.

Domestic paper recycling has modest levels as it does not exceed 50%. On the other hand, the percentage of recycled paper pulp differs greatly:

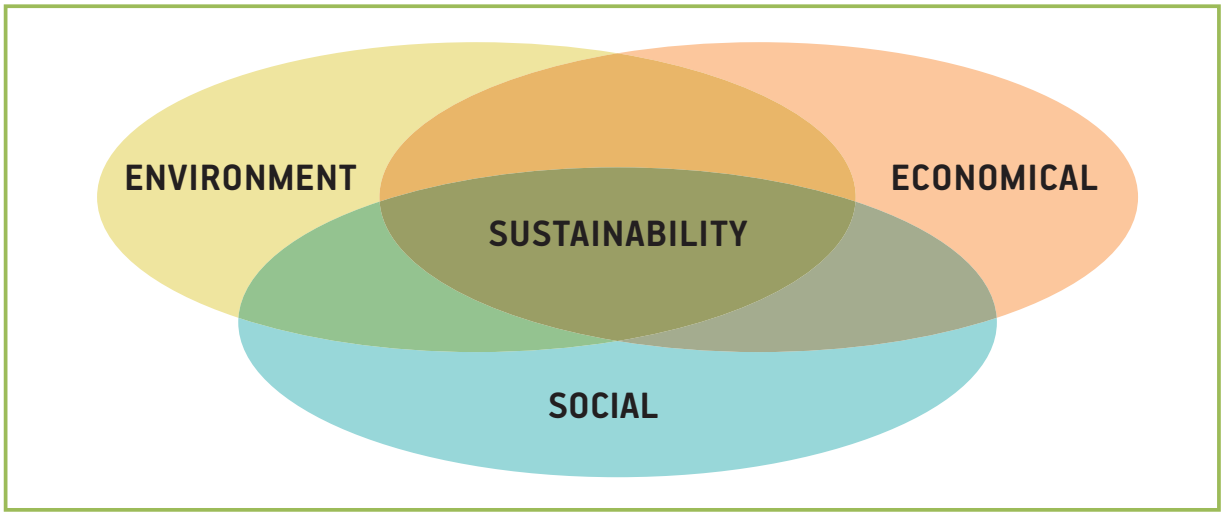
- Printing and writing paper (7%)
- News press (60%)
- Card (95%)
- Wrapping paper (45%)
- WC paper (55%)



Paper pulp manufacturing around the world comes from 17% primary forests; 54% secondary forests and 29% from plantations. In Spain there are 430,000 hectares of eucalyptus and pine allocated to produce paper. Of the average 176kg of paper used per each inhabitant every year, 85 come from Spain, 76 from other places in Europe and 15 from the rest of the world.

## Business sustainability

Aspapel (Spanish association of manufacturers of Pulp, Paper and Card) heads up the sector. It brings together fifty-one companies (many of which are transnational) that represent 90% of the sector in terms of production. Aspapel is part of the Confederation of European Paper Industries (CEPI) the Confederation of European Fine Paper Industries (CEPIFINE) and the Group of European Market Wood Pulp Users (UTIPULP). On a state level, it forms part of the Confederación Española de Organizaciones Empresariales (CEOE, Spanish Confederation of Business Organizations) and the Asociación Española de Cogeneration (ACOG, Spanish Cogeneration Association).




Source: SHERIN, Aaris. Sostenible. *Un manual de materials y aplicaciones prácticas para los diseñadores gráficos y sus clientes.* Barcelona: Gustavo Gili, 2009.

With eight five factories, the Spanish paper sector employs sixteen thousand people. As a consequence of the crisis, between 2007 and 2010 three cellulose and thirty four paper factories closed down, which has meant a decrease in the manufacture of 250,000 tons of cellulose pulp and 900,000 tons of paper manufacturing.

**Paper sector, 2010**
Data in thousands of tons

| Paper and card | |
|---|---|
| Production | 6,193.4 |
| Use | 6,447.9 |
| Import | 3,316.9 |
| Export | 3,062.4 |
| **Cellulose** | |
| Production | 1,864.9 |
| Use | 1,794.2 |
| Import | 896.2 |
| Export | 966.9 |
| **Raw Materials** | |
| Use of Wood without bark, in thousands of $m^3$ | 5,802.5 |
| Use of recovered paper | 5,103.4 |

Source: *Memoria de sostenibilidad.* Aspapel, 2012 (Sustainability Report).

When it comes to environmental sustainability, Aspapel has work committees for recycling, forestry and ecology. One of its accomplishments is the report on sustainability and the implementation of environmental management systems by some companies.

The sector's sustainability report follows the Global Reporting Initiative (GRI) guidelines, one of the requirements of the European Environmental Paper Network (EEPN) that considers itself to be the best available and internationally known mechanism to guide the industry towards open and transparent communication between interested parties. The thirty indicators are gathered into four main concepts: sustainable forest management, efficient and responsible production, recuperation and recycling, and contribution to quality of life. Specific goals are renewed with each report. Significantly, the third and last report has increased the indicator for forestry certification (installations with chain of custody, use of certified wood and manufacture of certified paper) lumping together, without mentioning individually, systems of forestry certification. Regarding eliminating chlorine from the whitening process, the report asserts that all of whitening is free of elementary chlorine, but it does not specify the percentage that is totally free of chlorine and that which is made with liquid chlorine.

The industrial process of paper manufacturing generates waste like bark, lignin, and the remains of fibres that are not suitable for recycling and these are used as fuel. This biomass represents a third of fuel that is used in co-generation, this amount is on the increase: in 2010, 64% of co-generation fuel was natural gas, and the rest biomass, with a small presence, smaller all the time, of fossil fuels.

Other waste from the papermaking ends up in the rubbish dump 35%, used in agriculture (32.4%), used in the ceramic industry (10.3%), for compost (8.5%) or for the cement industry (6.7%). And 3% is incinerated.

In Spain, carbon dioxide ($CO_2$) emissions from this sector amount to 4.4 million tonnes; sulphur dioxide ($SO_2$) emissions are 4,279 million and nitrogen oxide ($NO_X$), 12,371 million. Regarding the disposal of toxic waste, the chemical demand of oxygen is of 3kg per ton, the proportion of total suspended solids remains stable at 2.2kg per ton of cellulose and 0.8 kg per ton of paper. The absorbable organic halogens (AOX) have fallen to 0.116 kg per ton.



## The 70% club

Spain's paper industry recycles over five million tons of used paper. This data puts Spain at the head of recycling within Europe, only behind Germany, and almost the same as France and Italy. 4.6 million tons of paper and card are collected, that represents 71.9% (collection rate) of all the paper used. This means that since 2009, Spain has been part of the 70% club.

The volume of paper recycled for the industry is even higher, as it reached 79.1% (recycling rate). That means that the industry is capable of absorbing even higher levels of recycling; at present some of the paper collected is exported to China.

Used paper is collected by selective domestic, commercial and industrial services. The 4.6 million (2010 data) tons of paper that are recuperated each year in Spain mean savings of the equivalent of filling forty five large football stadiums, like Barcelona's Nou Camp, right to the top, and savings in landfill emissions of 4.1 million tons of carbon dioxide, that's over 1% of the total emissions produced in Spain each year.

Once the recovered paper has been collected, it is classified into sixty types, following an international classification system, depending on the type of paper or card to be manufactured. The paper from a newspa-

per of a particular day, placed in the blue container, can be reprinted after just a week.

The "Tu Papel 21" program allows for the assessment and certification of the local domestic and commercial paper collection. In 2010, twenty-two localities, belonging to towns that together have a total of 16 million inhabitants, had obtained this certification. The cities Alcoy, Barcelona, Palma, Lérida, Reus and Sabadell are on the list of the blue scroll certificate that is awarded with the "Tu papel 21" program.

Logo de la Papirola

The paper sector has especially been affected by the financial crisis between 2007 and 2010. In 2008, paper production fell by 4.5% and in 2009, by 11.1%, meaning it fell to the same levels as 2005. In 2010, an increase of 9.1% was seen, and over the last decade has seen a growth of nearly 31% in the paper sector.

Export has been a way to escape the crisis for this sector. In 2010, 52% of cellulose made was exported and 49% of paper. Three quarters of this production ended up in the European Union. To enable this export, lorries have increased their net load from 24 tons to 28 tons; this represents an increase of 16.6%, consolidating road transport despite the equivalent decrease in carbon dioxide emissions.

In terms of direct employment, the sector employs 17,200 people and there are an estimated 85,000 indirect jobs.

Should paper use be reduced? Yes, as long as this action doesn't bring with it a larger environmental impact caused by its substitute; for example, if plastic bags (non renewable resource) were to replace paper bags, or if decreasing newspaper sales bring about an increase in emissions from electronic devices. It must be highlighted that paper has a 70% collection rate, whereas the selective collection of electronic devices does not reach 20%, and their recycling rate is less than 1%.

## Crowdfunding

Collective financing or crowdfunding refers to group cooperation so as to obtain money or other resources through the Internet and credit cards so as to finance efforts and initiatives of people and organizations.

Crowdfunding can be used for many purposes and by many professionals: from artists that are searching for support to political campaigns or financing for new or small businesses.



In fact, crowdfunding is a donation, or in the case of books, a pre-purchase with special conditions on price, details and recognition, so as to make previously economically unviable projects viable. In other words, the middlemen are removed and readers are gathered before the book is even released.

In December 2010, the Verkami platform was born and put at the disposal of its creators. Eleven months later, Goteo came onto the scene, another platform that adds to the crowdfunding model, the possibility of obtaining help in the form of tasks or other resources.

Most of these financing platforms have a security mechanism, because if the economic aim of the project is not attainable within the given timeframe, the donations are not charged to the investors. This system was initiated by Kickstarter with the name *pledges*. However, others like Micro patronage use a system where people directly support the work of those who request it, making Internet donations. The term was popularized by blogger Jason Kottke when he gave up his day job as website designer and started to live of his blogs that are financed by reader donations.

This type of collective financing is used for all kinds of sectors and projects, like blogs, newspapers, music, independent art, etc. This represents a great change, as authors can interact with the readers regarding both financing and content. Leaving it in their hands could, for example, be suicide for conventional book stores. But environmentally it can resolve uncertainties regarding the order.

## Prudent print runs

Stock that is on the market at any given time, in bookstores and warehouses, is not free. Neither is the management of the space it takes up.

So as to adjust the print runs to demand, market research is a must, but in a changing and shrinking market, desires can turn into disasters. On top of this, in our throwaway society, time periods have been accelerated, making a new book akin to fresh produce that like fish cannot be left out without decaying.



To meet this phenomenon the answer is: Prudent print runs. This measure is a containing system that is possible thanks to the appearance of new phenomena: print to order systems, or advanced purchasing, that in turn allow for a new type of relationship between authors, publishers and clients, allowing for a certain amount of loyalty.

Electronic communication, at the same time, puts at the reader's disposal not only devices, but also ways to find what were before "unfindable" books and to access them with ease. Public libraries allow access to all their holdings now on a national level and in the not distant future on an international level.

In any case, the book is dying. The time is coming when it will deteriorate, be abandoned and nobody will want it. In a CD you can store nearly all of Greek literature, but it can be scratched when used. Computers are replaced; tablets break and are even shorter lived.

On one hand we have the old style book shops. On the other, libraries that are reservoirs storing printed culture. But it is not easy to access the full collection of any magazine.

The book becomes like the dog from the advert, abandoned on the roadside. The advertising slogan was "He would never do it". Different ideas have cropped up to ensure the book's life: offering free books in certain places, social or medical centres, etc. And also bookcrossing that follows the movements of any book that contains the systems inscription and identity.

Books, at any rate, often get abandoned next to the paper bin. And if no one picks them up they enter the recycling process.

## Bookcrossing

Bookcrossing is a kind of book club with no geographic limits. The books that are left by the people that are part of it are free. Leaving books in certain places set aside for this allows for them to be exchanged. Bookcrossing allows for a book exchange that's like an endless game.

On bookcrossing.com there are tens of thousands of book reviews, scores and recommendations. Every time a book changes hands, the participants can write and publish their opinion. The three "R"s from bookcrossing are read, register (using a bookcrossing code BCID and label) and release (so that someone else can read it: give it to a friend, leave it on a park bench, donate it to charity, forget it in a cafeteria, etc). Every time someone registers an entry in the book's diary you will be notified by email.



The bookcrossing promoters at times contact authors and publishers regarding the worry concerning sales that this free interchange causes them. On the website they have made the following statement: "Many publishers and authors are big bookcrossing fans. They've seen the paradoxical value in encouraging the sharing of books. In fact, if one were to compare the number of people who buy books based on seeing book reviews here as the books change hands, the number of people who actually find free books, we can assure you there are far more buyers than finders. This site is not about saving people money. Many of our members, in fact, purchase two copies of every book they like, so they can keep one and release the other into the wild!"

# 9. Measure and transmit environmental impact



Calculating the environmental backpack of a publication is a good way to measure its environmental impact and at the same time is a good informative tool directed towards its target audience.

In the Greening Books project, printer El Tinter is in charge of carrying out the environmental backpack tests at the beginning and end of the project, taking into account their experience in carrying out over a hundred back packs for previous publications (books and magazines) and incorporating the new knowledge discovered thanks to the project.

One of Greening Books aims is to achieve the most environmental information possible (raw materials, energy, transport and waste) of book and magazine publishing so as to enable the reduction of their impact on the environment.

In its first phase, they have calculated the ecological backpack of issue 13 (October 2011) of the Revista de Qualitat Ambiental (Environmental Quality Magazine), of the Departament de Territori I Sostenibilitat de la Generalitat de Catalunya (Department of Territory and Sustainability of the Generalitat de Catalunya) and the EMAS club. And they have also included the book *Disciplina y Resistencia: Trabajos forzados en la España de Franco* (Pamplona 2011), by Memoriaren Bideak and Eguzi Bideoak.

What is more, the same process has been carried out with three other books of different sizes and materials. For example, the calculation of the ecological backpack of the book *Hoy activos...o mañana radioactivos* by Jordi Bigues has allowed El Tinter to assess the impact of a book made with FSC paper measuring 15 x 21 cm.

In another case a book of the same size was chosen, but that used non FSC recycled paper: *Pequeñas ideas para garantizar un gran futuro*, by the advisory council for sustainable development of the Departament de la Vicepresidència (Vice-presidency Department) of the Generalitat de Catalunya (2010-2011).

And, finally, they calculated the ecological backpack of the book *Sustainable innovation strategies: Exploring the cases of Danone and Interface* (2011) by Marc Vilanova and Pax Dettoni.

In the project's final year, the second phase has been initiated, the pilot tests, starting with the environmental criteria gathered in the hand book and applying the now software tool, available thanks to the Greening Books project, that is explained in the next section.

## Environmental footprint

The study of the impact human society has on the natural environment has uncovered the need to establish comparative guidelines, that on one hand, inform of the impact in a local, regional and global setting and show the existing tendencies in this field, and on the other contrast the uneven distribution of these effects. This information can contribute to disclosing, when over understandable levels, the occurrence of the global and local impact.



The different studies have contributed to understanding the scope of the environmental crisis regarding the effects it has on our species and that is measured with indicators that allow the environmental impact to be quantified, like climate change, ocean acidification, depletion of the ozone later, disruption in the nitrogen and phosphorus cycles, excessive use of fresh water, careless use of the land, loss of biodiversity or chemical contamination as well as that caused by particulates released into the atmosphere. The objective is to determine the breakpoints of crucial environmental processes that are related to our species' dwelling on the Earth.

There are, however, three more elements to take into account: the demographic factor (judged by the amount of inhabitants and quality of consumption per inhabitant), the potential reception capacity (understood to be the load capacity, or maximum amount of members of a species that a determined habitat can indefinitely provide for), and the accumulated catastrophic potential (nuclear weapons and power stations).

The footprint is measured in units of the international unit system (SI). In this case the food or agricultural footprint is measured in hectares or surface units that are then divided by the number of inhabitants of the area in question.

The environmental footprint is a measuring method for assessing humanity's demands on the biosphere, comparing the human demand with the planet's regenerative capacity. Because of this, the environmental footprint is measured in equivalent surface units, and the environmental backpack in measures of weight, cubic meters or the equivalent litres. Why add the adjective "equivalent"? So we can sum up but without excluding.

The climate footprint is measured in kg of equivalent $CO_2$ (it includes the other green house effect gases that make up the climatic mix), and the equiv-

alent water footprint is expressed in litres. Even though the SI measurement is given in cubic meters, the equivalent energetic footprint is expressed in kilowatts per hour (kWh) even though this can include electricity (generated in various different ways) coal, gas and petrol.

As the footprint and environmental backpack need to access similar information from different places, it is very important to bear in mind what is included and what is not when the calculations are made, so as to know what we are talking about.

Really, when talking about the backpack, we are referring to the material's productivity, and how the production activity can be reduced so as to achieve more with less. But it is important to previously measure this productivity as an impact indicator, before reducing it or starting reduction strategies.



This new concept was developed by Friederich Schmidt-Bleecker from the Wuppertal Institute, and is expressed in MIPS (material intensity per service). The MIPS system allows us to estimate how many tons of kilograms of materials have been moved in some part of the earth for each defined service. It can be: rubble in a copper mine in Chile, or water, sand and solvents needed to get copper in Portugal, or the chemicals, additives and packaging used for final production in Stuttgart... as well as the use of materials when selling wholesale and retail.

### Books for a good climate

What is the book industries contribution to climate change? There is no answer to this question in our country due to lack of data. However in the USA, for example, they know that the book industry emits 12 million tons of greenhouse gases each year, and that the paper industry is the fourth highest when it comes to industrial emissions. In the USA, the average carbon dioxide emissions that are produced when manufacturing a book are estimated at 8.85lb, about 4 kg.

CERTIFIED RENEWABLE ENERGY

Green-e.org

This insignia highlights the products by American companies that are supplied with renewable energies: wind, solar, low impact hydraulic, biomass, etc. www.gren-e.org.

In Europe, the paper and pulp industries are included in an allocation plan for greenhouse emissions, so its climate impact is under control and subject to pressure to reduce these emissions.

We mustn't forget that books are carbon deposits that have a long life. They are made of cellulose, a renewable, natural and recyclable resource.

But if they end up in landfill, they emit methane, a greenhouse gas that is twenty times more active that carbon dioxide. According the Green Press Initiative, green house emissions associated with the publishing world are distributed as follows:



**Percentage emissions attributed to each phase of the life cycle**

| Industry segments | % of Greenhouse emissions | Notes |
|---|---|---|
| Forest felling | **62.7** | Fibre felling in the factories only accounts for 1.52% of the emissions. The rest, 61.22%, corresponds to the transfer of the biomass from the forest to the factory. From this percentage we must take away the recycling and energy recovery in paper plants and paper stocks in libraries or warehouses, that are carbon deposits. |
| Paper production | **26.6** | Paper production represents 22.4% of the total emissions, 4.16% of these come from printing and finishes; binding. |
| Landfill waste | **8.2** | Books left in landfill emit methane during decomposition. |
| Distribution and retail | **12.7** | Distribution of books to market. Energy is here used by the bookstores. |
| Publishing activities | **6.6** | Energy used in the offices, paper and travelling. |
| Carbon storage of the books<br>Incineration with energy recovery | **–16.8** | Books are carbon dioxide deposits: they contain carbon. As long as they are not abandoned in landfills, as then they generate methane, another green house effect gas. |

Source: *Reducción del impacto climático.* Green Press Iniciative.

Whoever buys a book takes on an asset, but they must know that there is also a liability: the emissions associated with processing and producing a renewable resource made with cellulose.

If a book is thrown out and ends up in landfill, they are contributing to the emissions associated with its decomposition: methane and carbon dioxide emissions, greenhouse effect gases, which are still not evaluated per unit.

The large scale of the problem of climate change implies that all parties involved should be responsible for the emissions, they are all called climatic agents: the suppliers of raw materials used in the printing process (paper, ink, plate, machine manufacturers among others) publishers, printers and readers.



As well as the people that want to compensate for these emissions. However, they must previously be reduced, after having calculated them and included them in the foreword and the paper's label as well as the book. And if possible more than once as has not been done up until now. Enough will never be done to compensate for what has not been done in the past.

We must not confuse live carbon with fossil or dead carbon. Fossil fuels that contain carbon (coal, petrol and natural gas) are underground. They are not renewable resources. On the other hand, live carbon is part of the open cycle of carbon that is carbon dioxide when in the atmosphere and when deposited becomes carbon within the organic compounds that make up living beings. Live carbon, is therefore, a renewable resource.

To emit X amount and compensate with the same amount X, is not at all easy. We do it with a movement (buying goods or services) and compensate two decades later if we plant a tree. In any case, if we emit X and compensate X, we cannot say that we are carbon neutral, or zero carbon. First we would have to calculate, inform and then reduce. Smoke curtains are smoke curtains, whether of carbon or soot.

In summary, it is very important to measure and transmit any environmental impacts so as to improve the production processes and keep users informed. Calculating the ecological backpack is a good way of gauging impact and at the same time is a good communication tool for end users of the product in question.

## Eco-publishing's eco-label

47% of people surveyed by the European Union's 2011 Euro-barometer consider that the labels used presently identify products that are eco-friendly. 5% don't know and 48% think they don't; that the labels used at the moment do not identify products that represent a considerable environmental improvement.

These labels already have willing support. Up to 72% of those surveyed would be willing to buy eco-friendly products, even if they cost more. For consumer associations, some of these labels are pulling the wool over our eyes, as they feel that some are unfounded and others have no environmental value, or are incomplete, irrelevant, vague, etc.



In any case, demand shows that they must include the reduction of environmental impact reached during the whole life cycle of the products and all relevant materials.

These demands are present in the eco-publishing eco-label, a simplified environmental product statement.

## The Eco-publishing statement label

### Environmental publishing statement

The amounts are the totals obtained in each section, divided by the number of copies.

***Block 1***

➔ **Insignia of the European Union's eco-label for paper and printed-paper.**

➔ Title and basic book identification.
Authorship acknowledgement or the CIP (cataloguing in publication) will appear on the second page.

➔ QR (quick response) code is a matrix barcode that allows access to information via the Internet.

***Block 2***

➔ **Identification of companies' environmental certificates**. In first place, the environmental management systems of the companies involved; in this case, publishing, design, and production, with the corresponding emblems.

***Block 3***

➔ **Materials used.** Commercial name in the first column, environmental insignias and in the last column their description.

***Block 4***

➔ **Report of verified good environmental practices** obtained and updated by the companies involved that are identified in block 2.

***Block 5***

**Ecological backpack** by product unit.



➔ **Weight of the publication**

Expressed in grams (g).

➔**Waste** generated during paper production and during printing.

**Below:** Waste that would have been generated during conventional paper production and using a printers without an environmental management system.

Expressed in grams (g).

➔ **Hydraulic footprint**, from the use of water while manufacturing paper for the book and during printing.

**Below**: Water that would have been used in manufacturing a similar, conventional paper, and during printing.

It **does not include** water used for tree growth.

Expressed in litres (L).

**Use of raw materials**

➔ **Use of recycled paper**

Weight of the raw materials needed to make the recycled paper for this publication. To make a ton of recycled paper you need 1.235 tons of used paper. You need 2.4 tons of wood to make the cellulose, to make a ton of new paper some fourteen trees between fifteen and twenty years old with a trunk of 20cm diameter.

**Below:** Weight of raw materials needed if the publication was made with virgin paper.

It **does not include** binding materials.

Expressed in grams (g).

**➔Use of inks and presence of toxic substances**

Inks made with vegetable oils. The use of these inks brings about savings in the use of non-renewable resources that come from petrol and in generating volatile organic compounds. The fact that it is paper with the Eco-label, excludes or limits the amount of toxic substances, but does not mean it is completely free from chlorine (TCF) or that during its production it has followed a chlorine free process (PCF); so it could be elemental chlorine free (EFC).

**Below** Savings achieved by not using more contaminating inks.



**It does not mean they are totally free of toxic substances**

Expressed with the symbol.

**➔Energetic footprint**

Total amount of electricity used during the manufacturing, printing and delivery; reflects eco-efficiency. The manufacture of a ton of new paper, uses on average 9,600 kWh, and a ton of recycled paper used 3,600 kWh.

**Below**: the amount of electricity saved by using recycled paper.

It **does not include** the electricity used in finishing the product or in any transport after it has reached the distribution point.

Expressed in kilowatts per hour (kWh).

**➔Climatic footprint**

The impact on the climate taking into account the use of electricity from the conventional grid and the official equivalent carbon dioxide parameters by kWh, in the paper manufacture and printing.

**Below**: Emissions that would have been produced, during its manufacture and printing, if conventional paper had been used.

It **does not include** the saving in emissions that would have been generated if only renewable energy has been used. In this case, it would register as a good practice, in the first place, and what is now an emission would figure as a saving. The degree of efficiency however, is calculated with the energy footprint.

Expressed in grams of equivalent carbon dioxide ($CO_2$ eq.).

**➔Radioactive footprint**

High activity radioactive waste generated by each kWh of electricity used from the grid, based on the energy footprint (electricity used in manufacture of paper and printing) and the milligrams of equivalent radioactivity per kWh.

**Below:** Mention the radioactivity that would have been generated if conventional paper were used, during its manufacture in Spain (with a higher electrical use) and printing (with a similar energy use in the two options compared).
It **does not include** the radioactivity spread in the concentration of uranium or during the preparation of nuclear fuel.
Expressed in milligrams (mg) in equivalent Becquerel (Bq). Each mg of high activity radioactive waste has a radioactivity of 10 million Becquerel, the minimum potential amount for radioactive contamination is 10,000 litres (with 1000 Bq being the set maximum admissible amount, [NMB] per L) per kWh used. In 2011 the radioactivity generated from the Spanish electrical mix was of 0.55 mg of high activity radioactive waste per kWh (5,500,000 Bq per kWh, equivalent to the potential contamination of 5,500 l of contaminated milk).



It is also important to compare the radioactivity associated with the book to the total annual radioactive average divided by the number of people. A total of 160 tons of high activity radioactive waste, divided by 45 million gives a result of 355 milligrams per person per year as a radioactive footprint, according to ENRESA, the state owned enterprise in charge of managing radioactive waste.

# 10. Instruction manual for the Greening Books computer program



## The Greening Books Project bookDAPer tool and bDAP eco-label www.bookdaper.cat

BookDAPer is the Greening Books project software tool and is used to generate the bDAP eco-label for paper publications.

This tool allows publishers, designers and printers of paper publications to generate and obtain the bDAP eco-label for their publications. Then this eco-label and all its information can be included in the publication itself with the aim of informing the reader of the publication's environmental behaviour.

The bDAP eco-label and the bookDAPer software are a simplified environmental product declaration (EPD) which calculate and show the publication's environmental behaviour and state the certificates as well as the good environmental practices of the companies involved, always in the same format, applying the same rules and criteria.

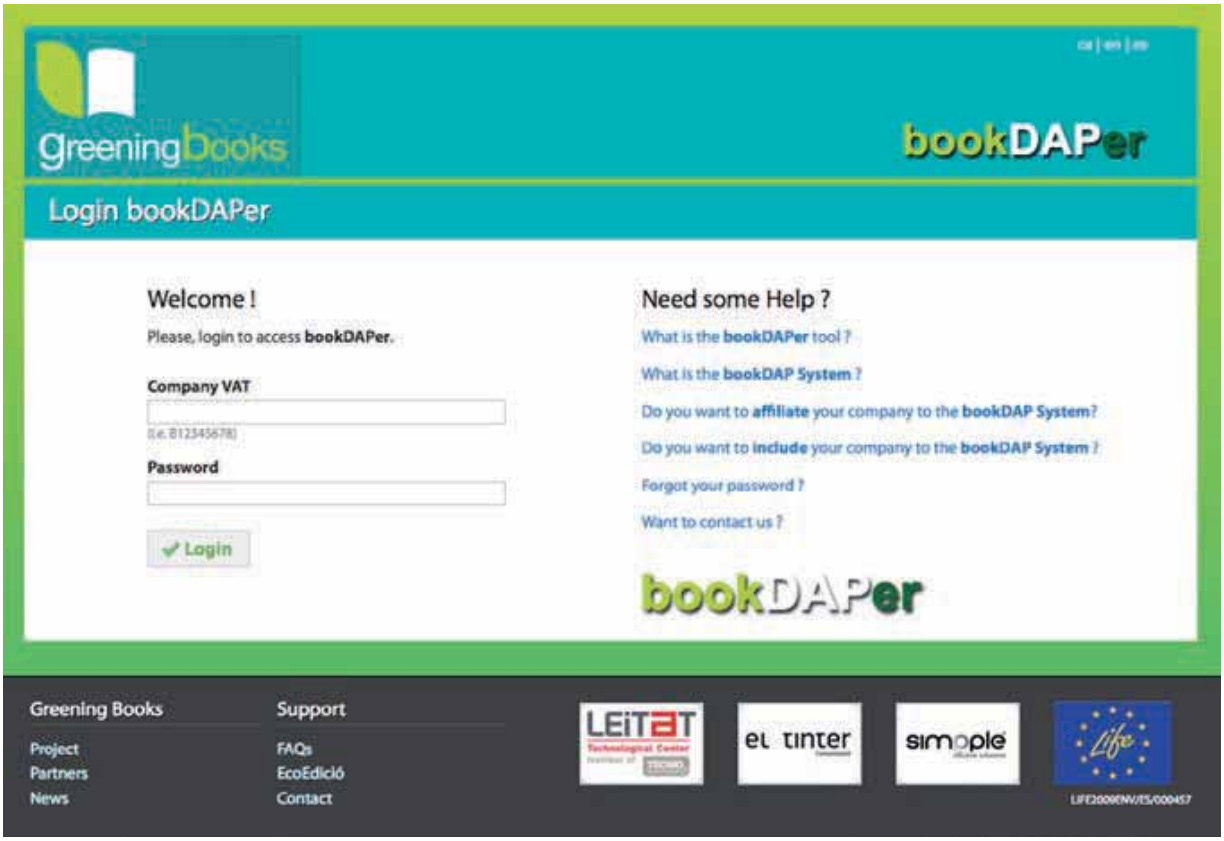
The bDAP eco-label is made up of four different sections:

1. In "Environmental management" it details the environmental certificates belonging to the companies involved in publishing, designing and/or printing of the publication.
2. In "Materials – Paper" it details the environmental certificates of the main product used in the publication; the paper used.
3. In "Good practices" it mentions all the verified good environmental practices of the companies involved in the publishing, design and/or printing of the publication.
4. Finally in "Ecological backpack" they list the results of the calculations of the following environmental pointers associated to the life cycle of the publication under evaluation: carbon footprint (g $CO_2$ eq), waste generated (g), water use (L), energy use (kJ) and use of raw materials (g).

The content of each of these four sections of the bDAP eco-label is checked by the bookDAP verification team, with the aim of guaranteeing the truthfulness and accuracy of the information supplied by the companies using the system. Hence, for example, the environmental certificates that the companies claim to have must be accompanied by the number or code of said certificate or the permission's entitlement; to claim the application or consideration of a certain good environmental practice; first the required documentary evidence must be supplied and verified.

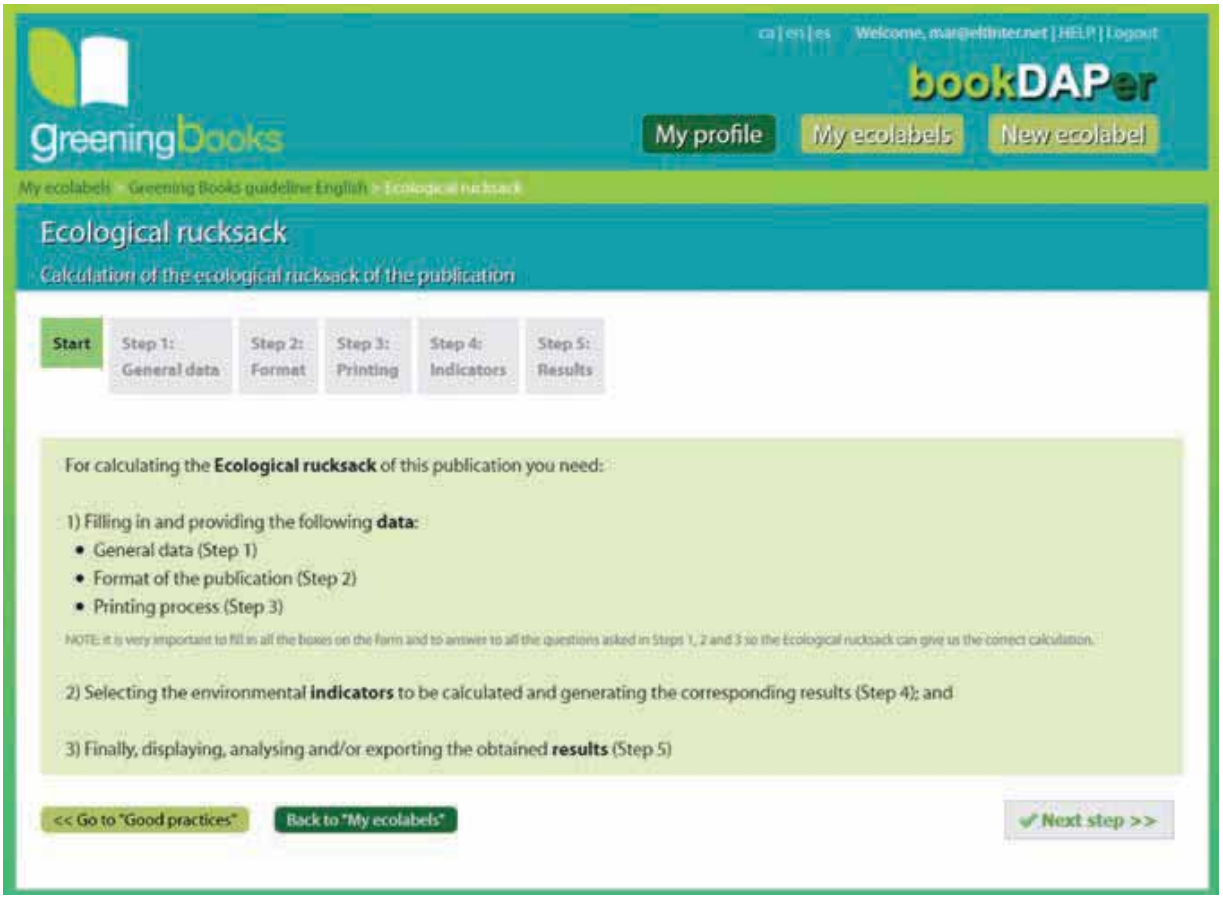
This eco-label is an instrument for environmental communication and recognition that intends, on one hand to reward efforts in eco-publishing and enable continual environmental improvements by the companies involved in publishing, design and/or printing of paper publications and, on the other hand, inform the reader more objectively and drive home the need to demand for more environmentally friendly publications.



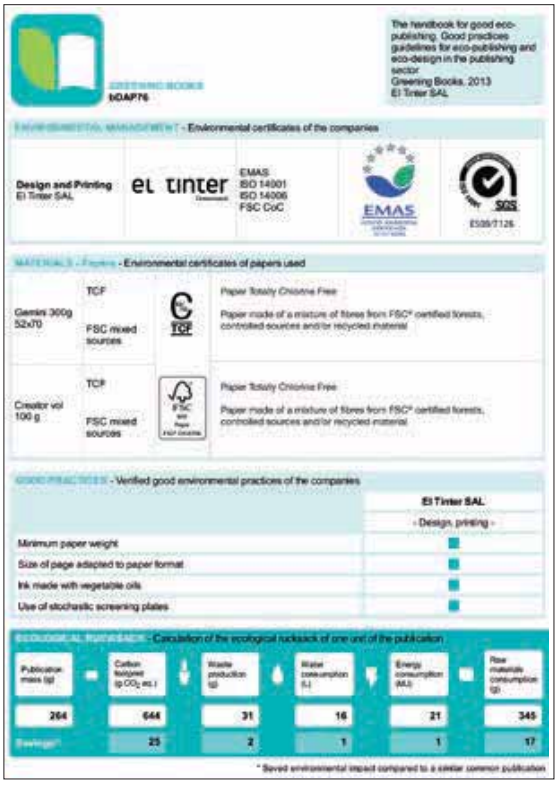



bookDAPer home screen

**www.bookdaper.cat**




Data entry screen for eco backpack calculations.




Greening Books Project bDAP eco-label.

# 11. Conclusions and Good Practices



Following is a summary of the conclusions of the *The handbook for good eco-publishing. Good practices guidelines for eco-publishing and eco-design in the publishing sector (books and magazines)*, a key document for all those involved in the European project, Greening Books.

## EMAS and eco-label

It is advisable that companies have environmental management and audit schemes (EMAS). Whether they are printers, publishers, paper mills, design studios, etc, if they have an environmental management audit scheme they will have access to data that will then allow them to work better and improve. EMAS give the working system an order and provide stable data.

The best systems are the EMAS, which, as well as being backed by the European Union is transparent.

Mid 2012, the printed-paper Eco-label was published. This is a very important aspect, as it allows, with just one label, a summary of many of the requirements of a good environmental printing. This label is still (at the end of 2012) in its implementation process, but will be one of the best tools for improvement for books and printed products.

## Recycled paper

Recycled paper has radically different impact values. The fact that the material which makes up 95% of the weight of any publication is recycled is an important factor.

## Chain of custody

It is important for paper to follow a chain of custody. Out of the different custody chains the most well known, with the most serious criteria is the FSC. It allows control over the origin of the paper, as it guarantees that it comes from sustainably managed forests, from factories that have worked the paper pulp taking into account sustainable criteria, from distributors that have cared for it until it arrives at the printers and so on.

It is also important to know that the paper from a custody chain can also be recycled, that it doesn't just have to come straight from the forest, but it can be mixed: forest and recycled or even just recycled.

## Durability and Chlorine

Paper must have a standard durability. And in the manufacturing process certain production systems must have been eliminated, i.e., contaminants like chlorine. Good paper is completely chlorine free.

As present there is a large supply of totally chlorine free paper and it can be used for many different products.



## Inks and plates

Less contaminating materials must be used. In the case of inks, they are made with vegetable oils. Evidently, with ink it still can't be said that the zero contamination issue has been resolved, because in some colours we still find heavy metals, etc.

Regarding the plates, presently we recommend the use of stochastic screening that minimizes the environmental impact both in the etching process and in the use of ink in the printing process.

## Eco-design

ISO 14006 regulating eco-design allows for a thorough study of the product, and from there also offers the solution most suited to the consumers needs.

Eco-design allows for the study of material resources and energy used in the process, and to identify the incorporation of environmental criteria that contribute to the improvement of the products' connection with the environment; reducing the use of resources (energy and raw materials) and emissions (into the atmosphere as well as solid waste). Resources are getting more expensive by the day, therefore savings in this area helps providing more competitive offers.

## Formats

In book, magazine or series design, there is an essential criterion that is to define the format taking into account the type of paper and the production process. It is, probably, one of the most complex processes, as the final size of the book or magazine needs to be taken into account, as well as the measurement of the paper and card in the manufacturing process and the formats of the plates and the printing press.

## Finishes

The three most popular styles of binding are: paperback, hardback, and flaps. Each one has a different impact, depending basically on the weight of the paper or card. The impact of this weight must be considered. The binding systems include metal staples and vegetable thread, the second one being the more recommended of the two.

## Waste management

Is it possible to minimize waste? What can we do with waste? There is a practice that paves the way for improvement. Firstly the waste must be properly managed. Then plans to minimize it must be made (these are required by law when it comes to special waste) Third, zero waste must be considered, that is, thinking of waste as a nutrient in the metabolic process.



## Distribution and logistics

For logistics to function correctly, packaging is vital. Normally these boxes are made of recyclable cardboard.

When it comes to print runs, it is considered normal that the price per unit goes down as the amount of copies goes up. This concept is true but has terrible consequences when much more is printed than is needed.

One solution is that of pre-purchase, for example, using a crowdfunding process.

Another is to print on demand. Combining digital and offset printing are essential for this to work.

## Useful till the end

Where do books or magazines end up? We are lucky because today books do not go to landfills. But, where do they go and what do we do with them? What do they represent? They are in libraries, both public and private, used for bookcrossing...and finally handed over for selective collection.

## Electronic books

Paper format books and magazines live, and will live alongside the new electronic format. It is just a case of choosing well what format we want to use to communicate with others.

We must demand, however, that the same is done with electronic media as with paper books and magazines; that those responsible calculate, inform and attempt to minimize the environmental impact of books and magazines that are to be read electronically.

## Ecological backpack

The ecological backpack is the crux of the matter, the mainstay of this proposal for improvement in the book chain value sector. As it allows us to assess the environmental impact that publications have and to quantify what is called the ecological backpack, that defines the energetic and hydraulic impact as well as waste, materials and $CO_2$ emissions.

The BookDAPer program allows calculations in grams, kilos, kWh, etc, and compare them with standard values and other parameters. It is therefore, an excellent tool for better management in this sector.



It is also an excellent tool for magazine readers, as it allows them to know what the environmental improvements in graphic production in the publishing field have been, and to make an informed decision.

## Good Practices

| | |
|---|---|
| 1 | Minimum paper weight |
| 2 | Size of page adapted to paper format |
| 3 | Paper cut-offs to be viewed as useful by-products |
| 4 | Ink made with vegetable oils |
| 5 | Use of thin typefaces |
| 6 | Use of stochastic screening plates |
| 7 | Replacement plan for all substances that are hazardous to human health and the environment |
| 8 | Zero use of Isopropyl alcohol (IPA) |
| 9 | Use of renewable energies |
| 10 | Waste reduction |
| 11 | Prudent print runs according to demand |
| 12 | Packaging using recycled carton |
| 13 | Use of transport with low carbon dioxide emissions |
| 14 | Embrace the zero waste strategy |
| 15 | Embrace the voluntary $CO_2$ emission reduction agreements |
| 16 | Good practices of Catalunya's Graphic Industry Guild |
| 17 | Sustainability report according to the guidelines established by the Global Reporting Initiative (GRI) |
| 18 | Equal opportunity plan for both sexes |
| 19 | Book "Friend of the forests" |
| 20 | Made by cooperatives |

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**GREENING BOOKS**
**bDAP76**

The handbook for good eco-publishing. Good practices guidelines for eco-publishing and eco-design in the publishing sector
Greening Books, 2013
El Tinter SAL

## ENVIRONMENTAL MANAGEMENT - Environmental certificates of the companies

| | | | | |
|---|---|---|---|---|
| **Design and Printing**<br>El Tinter SAL | el tinter Comunicació | EMAS<br>ISO 14001<br>ISO 14006<br>FSC CoC | EMAS GESTIÓ AMBIENTAL VERIFICADA ES-CAT-000058 | ISO 14001 SYSTEM CERTIFICATION SGS ES09/7126 |

## MATERIALS - Papers - Environmental certificates of papers used

| | | | |
|---|---|---|---|
| Gemini 300g 52x70 | TCF<br>FSC mixed sources | %TCF | Paper Totally Chlorine Free<br>Paper made of a mixture of fibres from FSC® certified forests, controlled sources and/or recycled material |
| Creator vol 100 g | TCF<br>FSC mixed sources | FSC MIX Paper FSC® C016706 | Paper Totally Chlorine Free<br>Paper made of a mixture of fibres from FSC® certified forests, controlled sources and/or recycled material |

## GOOD PRACTICES - Verified good environmental practices of the companies

| | **El Tinter SAL** |
|---|---|
| | - Design, printing - |
| Minimum paper weight | ■ |
| Size of page adapted to paper format | ■ |
| Ink made with vegetable oils | ■ |
| Use of stochastic screening plates | ■ |

## ECOLOGICAL RUCKSACK - Calculation of the ecological rucksack of one unit of the publication

| Publication mass (g) | Carbon footprint (g $CO_2$ eq.) | Waste production (g) | Water consumption (L) | Energy consumption (MJ) | Raw materials consumption (g) |
|---|---|---|---|---|---|
| **264** | **644** | **31** | **16** | **21** | **345** |
| **Savings*:** | **25** | **2** | **1** | **1** | **17** |

* Saved environmental impact compared to a similar common publication