CROSS INDUSTRY SPECIAL REPORT

GB

Carbon Footprint & Energy Reduction

for the Graphic Industry Value Chain

connection of competence

PrintCity

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Printing, Paper, Publishing and related organisations

CEPI — Confederation of European Paper Industries *www.cepi.org*
ECMA — European Carton Manufacturers Association
EuPIA — European Printing Ink Association *www.eupia.org*
EUROPEN — European Organisation for Packaging and the Environment *www.europen.be*
FAEP — European Federation Of Magazine Publishers *www.faep.org*
Intergraf *www.intergraf.eu* / Graphic Association of Denmark / BVDM / UNIC
PostEurop A.I.S.B.L *www.posteurop.org*
FEDMA — Federation of European Direct and Interactive Marketing *www.fedma.org*
ERA — European Rotogravure Association *www.era.eu.org*
VDMA - Verband Deutscher Maschinen - und Anlagenbau - German Engineering Federation *www.vdma.org*
WAN-Ifra — World Association of Newspapers and News Publishers *www.wan-ifra.org*
FIPP — Federation International of Periodical Press *www.fipp.com*
PPA — Periodical Publishers Association *www.ppa.co.uk*

Other useful sources and web sites

ADEME — Agence De l'Enviroment et de la Mairise de l'Energie *www.ademe.fr/bilan-carbone/ www.compensationco2.fr*
Carbon Trust, UK *www.carbontrust.co.uk*
CSR Europe — Corporate Social Responsibility Europe *www.csreurope.org*
David Suzuki Foundation *www.davidsuzuki.org*
ERPC — European Recovered Paper Council *www.paperrecovery.org*
SPC — Sustainable Packaging Coalition *www.sustainablepackaging.org*
UNEP — United Nations Environment Program *www.unep.org*
World Council for Sustainable Development *www.wbcsd.ch*
US EPA — US Environmental Protection Agency *www.epa.gov*
FSC — Forest Stewardship Council *www.fsc.org*
IEA — International Energy Agency *www.iea.org*
PEFC — Programme for Endorsement of Forest Certification Schemes *www.pefc.org*
SFI — Sustainable Forestry Initiative *www.sfiprogram.org*
Ecoinvent data bases *www.ecoinvent.ch*
CO_2Stats green site website vertification *www.CO2stats.com*
Climate Change Connection *www.climatechangeconnection.org*

Introduction

Carbon & energy reduction for the graphics industry value chain

Climate change is accelerating. The year 2010 was the warmest* since at least the middle of the 19th century and possibly for 125 000 years according to James Hansen, University of Colombia, in spite of an unusually cold autumn and winter in Europe. (*UN World Meteorological Organisation data, January 2011, is the average from research teams at the UK Hadley Centre, NASA and NOAA in the US.)

The primary cause of global warming leading to climate change is greenhouse gas emissions (GHG) produced by a wide range of human activities. The 'greenhouse effect' is not new – in 1863 Irish-born scientist John Tyndall was writing about GHGs, and in the 1890s the Swedish scientist Svante Arrhenius made the first known attempt to calculate the impact of increased carbon dioxide in the earth's atmosphere.

Human generated climate change is global and only coordinated international action can resolve it. Under the 1997 Kyoto treaty 37 industrialised countries agreed to reduce their collective GHG emissions by 5.2% from the 1990 level (8% for the EU-15). Major emission producers who had not implemented Kyoto – USA, China, India and Brazil – are now participating in negotiations to replace the treaty, which expires in 2012. Progress is slow and currently hampered by a political divide of responsibility between developed countries and newly industrialising economies. The related financial responsibilities are difficult to address by national political institutions in the short term. In late 2010 there was some consensus to an environmental tax on air and sea transport. The 2010 Cancun UN environmental conference established some new agreements to minimise and control emissions.

Significant segments of business and industry would welcome a new global treaty that gives them a clear legislative business environment within which they can make long term investment decisions with some security and, also, ensures that the global competitive playing field is relatively level.

Climate change, resource availability, waste disposal and pollution are linked to sustainability. Sustainable development calls for long-term changes in patterns of production and consumption to meet the needs of the present without compromising the ability of future generations to meet their needs.

Climatic and other environmental issues already have an accelerating impact across the industry-wide process and value chain systems of publishers, advertisers, packagers, printers, and their suppliers. The European industry has been proactive in its response, with industry associations like CEPI, Intergraf, PostEurop, and PPA developing carbon footprint methodologies and calculators. The optimum response to the carbon and energy challenge is in collaborative work across the industry value chain. One example is the Strategic Workshop of European Graphic Industry Value Chain on Carbon Footprint Standardisation in 2010, hosted by CEPI, FAEP, FIPP, Intergraf, PrintCity, VDMA and WAN-IFRA, with representatives from other graphic industry associations, which defined a common vision:

1. Carbon Footprinting is a tool to help reduce carbon emissions and is becoming a fundamental regulatory requirement. It is one part of sustainability, not the whole, and needs to be viewed within the overall environmental context.
2. Carbon Footprinting is also an evaluation tool to help increase energy efficiency.
3. International harmonisation of carbon footprint definitions, methodology, and data is needed.
4. There is a need to resolve uncertainty on some key issues: energy, biogenic, and end-of-life stage.

There is currently a dual approach to international harmonisation. An ISO Working Group was set up in October 2010 to explore the environmental impact of print, including a harmonised carbon footprint calculation, within the framework of the ISO draft 14067. In early 2011 a pragmatic alliance of European printing associations combined existing work from industry sectors to provide coherent calculation procedures and transparent data exchange. The important point is that the industry proactively tackles this issue and positions itself in the climate change issue as an international industry leader.

Sections of the electronic media and their suppliers position themselves as being more environmentally friendly than print – a mantra that is generally erroneous or incomplete. Both paper and electronic media have a place in a sustainable future and the question is not which medium is environmentally preferable but, rather, how both platforms can work together to reduce the overall environmental burden.

Why a PrintCity carbon footprint and energy project?

The purpose of this guide is to help provide some clarity to this complex subject, providing information on issues, strategies, techniques and technologies to help improve the overall cost and environmental performance of printers, publishers, brand owners, and their suppliers.

The report seeks to promote, in principle and practice, that the optimum response to the carbon and energy challenge resides in collaborative working across the industry value chain – printers, publishers, their associations and suppliers working within a common framework. Currently, this is 'work in progress' that needs to be completed.

Some of the content of this report is drawn from the publications of organisations (listed opposite) and we recommend that you consult the original publications for more information.

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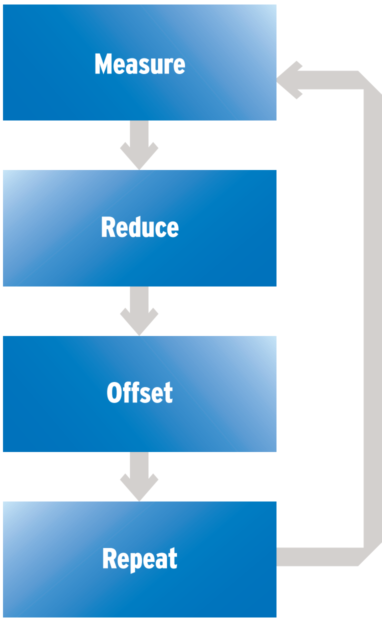
Executive Summary

'The cheapest and cleanest kWh of energy is the one not used'.



Emissions and Energy reduction is a set of 3 repetitive steps. Source UPM

A Lean and Green manufacturing strategy improves both environmental and business performance.
Source PrintCity

Carbon & energy reduction … work in progress

For every business and inhabitant of the planet the transition to a low-carbon and more sustainable society is becoming one of the single most important drivers of the first half of the 21st century. Therefore, environmental issues will have an increasing impact on the graphics industry value chain for publishers, advertisers, packagers, printers, and their suppliers.

There is a direct correlation between CO_2 fossil emissions, energy generation and consumption. The industrial revolution was sustained by fossil fuels that drove carbon extraction and combustion, with its subsequent effect on the climate. Coal is still the emissions 'king' in terms of CO_2 emissions even in the 21st century. Avoiding catastrophic climate change requires a massive reduction in GHGs from 1990 levels.

European carbon emissions continue to decrease and could over achieve the Kyoto target by 5,1% but if only if all so called additional measures are implemented. A further positive point is that pulp, paper and printing is responsible for only 0.6% of total GHG emissions in Europe, and these have dropped by 3% from 1990 to 2008, while production has increased by around 12%. In 2008, the EC defined its 20/20/20 mandatory reduction targets by 2020 (20% reduction of GHGs / 20% increase in energy efficiency / 20% increase of renewable energy sources).

One of the key issues is how much would a massive reduction in GHGs levels cost? A recent Intergovernmental Panel on Climate Change (IPCC) report states that the most stringent mitigation target would reduce global growth by 0.12% per year to 2050; it could be less.

According to Corporate Social Responsibility (CSR) Europe "The sustainability issue is now a priority across boundaries – political, cultural and professional. In a business context, sustainable development means taking a triple bottom-line approach so that the business measures its success not just on financial performance but on its environmental and social performance too". Research from the UK's Carbon Trust in 2009 showed that 63% of consumers are more likely to buy a product if they know action is being taken to reduce its carbon footprint.

Clean technologies themselves are already a big business with a global revenue in 2009 of $530 billion according to HSBC — this is about the size of the Swiss economy and bigger than the telecom services and media sectors

Why is energy policy important?

There are three realities concerning energy that impact on all users:

- Conventional energy supply is limited and many alternatives are expensive = need to reduce.
- The cheapest kWh of energy is the one not used = need to improved energy efficiency.
- Significant reduction of fossil fuelled energy = need to have cleaner generation.

The energy challenge is not just the massive reduction in GHGs in developed countries but also that world population is predicted to increase substantially, with many countries moving to more developed economies with an increasing demand for energy. Four trends that will shape the world's energy system this century are electrification, decarbonisation, localisation and optimisation.

An energy strategy that takes only the carbon factor into account is simplistic because GHG emissions are significantly influenced by the source of energy used. Climate change is linked with resource use, waste disposal and pollution within sustainable development — therefore, any single dimension (such as the carbon footprint) is an inadequate basis on which to make balanced environmental decisions. For those companies seriously interested in reducing their overall energy consumption, the measurement of the total energy used is essential. The most suitable single unit of energy to use is the Tonne Oil Equivalent (toe).

Carbon responses

The objective of Carbon Footprinting is to measure the emissions of a business, production site, product, or service. The primary reason to do this is to drive steps to reduce GHG emissions and fossil energy use. A secondary reason is to act as a base for carbon compensation and communication. Current sector or national Carbon Footprinting approaches are confusing, costly and complex – they need to be clear, concise and credible. A uniform, international approach to Carbon Footprinting that takes into account all elements of the graphics industry value chain is required.

Political administrations are increasingly looking at standards, labels and other instruments relevant to consumers to involve them in climate change mitigation. Therefore, attention goes beyond the carbon emissions of production activities, companies or sectors, focussing also on emissions associated with products.

There are a number of Carbon Footprinting issues that need to be resolved: the definition of boundaries can be the source of incompatibility, confusion and concerns over data precision; how to calculate energy mix and conversion factors; avoided emissions are not covered in standards and are seen as having a sliding scale of creativity and credibility. More clarity is also required for carbon sequestration, neutral/offsets, and trading.

Carbon impact on print & electronic media

It is estimated that internet data centres are responsible for around 1% of all GHG emissions — about a quarter of the ICT (information and communication technology) footprint of 4% (Gartner). These figures may be higher as a German Federal government report estimated that ICT took 10,5% of the country's electricity consumption in 2007. In a sustainable future, paper and electronic media each have a relevant place. Misplaced perceptions that electronic media are more environmentally friendly than print confuse the issue. The real question is how the two platforms can work together to reduce the overall environmental burden. The internet will also be crucial to a low carbon world by facilitating smart energy grids. Therefore, it is not just technology developments that will affect the growing carbon footprint of the internet, but more importantly how this medium is used.

The pulp and paper industry is one of the world's largest users of renewable, low-carbon energy. Around 50% of the primary energy used (e.g. purchase fuels) to make paper in Europe and the US comes from carbon neutral renewable resources and is produced on site at mills. In comparison, most IT data systems rely on conventional distributed power generation using fossil fuels.

Recycling can have a significant impact in the reduction of GHGs and energy use. The paper industry is the recycling leader in Europe with over 50% of its raw materials for production coming from recovered products.

Carbon Footprint value chain — making it 'leaner and greener'

Mapping of value/process streams identifies the multiple sources of CO_2e and energy consumption. The most effective optimisation approach is to work across the entire value stream to measure, identify and prioritise areas where improvements can be made; this should take into account:

1. What parameters are under control of the printer/the customer/the suppliers?
2. What actions have low cost and short term to implement – expected return on investment?
3. What actions have higher cost and mid- to long-term implementation – expected return on investment?

Improvement measures can be direct and indirect. Direct measures include, for example, energy savings achieved by technical or organisational changes and substitution of raw materials (or of a supplier or a process). Indirect measures may involve such actions as positively influencing employees' behaviour, e.g. switching off light/equipment whenever not needed, implementing improved processes with suppliers or customers, e.g. optimised logistics. You can't manage what you don't measure. Therefore effective reporting is an essential action in conjunction with Reduce, Reuse, Recycle.

Printing process optimisation should begin with control of the workflow and process, the use of quality standards and profiles to minimise paper waste, overinking and excessive drying energy. Optimised maintenance is also crucial to minimise consumption of energy and materials.

New technologies can provide significant reductions in energy consumption and emissions. However, the industry has relatively long reinvestment cycles, which means there will be periodic large step change improvements.

This report concludes that the graphics industry has made significant improvements to its carbon and energy efficiency. However, these issues are ongoing and will remain 'work in progress' for many years.

Some initial conclusions . . .

1 Climate change is a dynamic international issue driven by geopolitics, NGOs, legislation, customers, and users. It remains a key global political issue because climate deterioration continues. Energy and GHGs are important legislative and commercial factors.

2 Fossil fuelled energy supply is limited and it will become more expensive. Energy optimisation is a key to reducing demand, GHG emissions and related business costs.

3 'Lean' and 'Green' frequently go hand-in-hand to improve both environmental and business performance.

4 Carbon Footprinting is an evaluation tool to measure the environmental impact of a product or process. It facilitates the reduction of energy consumption leading to lower GHG emissions and provides a calculation base to offset emissions that cannot be reduced.

5 Current sector or national Carbon Footprinting approaches are confusing, costly and complex – they need to be clear, concise and credible. A harmonised international approach to applying Carbon Footprinting across all elements of the graphics industry value chain is required. Carbon Footprinting will be challenging for small companies unless simplified.

6 Uncertainty needs to be removed from some Carbon Footprint issues, including definition of scope or boundaries, methods to calculate energy mix and conversion factors, avoided emissions, sequestration, and biogenics – many of these are general issues that, nevertheless, concern the graphics industry. A key issue is the calculation of emission factors called "secondary data" in the future ISO14067 along with transparent reporting and communication.

7 Caution – the inappropriate use of Carbon Footprinting as a single parameter to compare goods or services can lead to unbalanced environmental decisions.

8 For those companies seriously interested in reducing their overall energy consumption, it is recommended to use Tonne of Oil Equivalent (toe) as a parallel metric to CO_2e.

9 Inflation of ecolabels leads to confusion and their devaluation (over 300 label types from more than 200 countries).

10 Ink-on-paper is not always perceived as being environmentally friendly but it is the only media with a one-time carbon footprint – all other media require energy every time they are looked at.

. . . work in progress

Glossary

Lifecycle Analysis (LCA) concepts include:

Cradle-to-Grave: Materials and energy needed to make a product from their extraction to their discarded destination.

Cradle-to-Gate: LCA of the environmental efficiency of a product or service until it is produced or delivered. It is often is used for environmental product declarations (EPDs).

Gate-to-Gate: Reviews individual production sites. A reporting tool available for many years is Paper Profile – a uniform voluntary declaration for presenting environmental product information.

Cradle-to-Cradle: Considers the whole lifecycle, including if the grave of one cycle can be the cradle of another, e.g. printed products are collected as waste paper after use and reused to produce paper again. Even the by-products from these processes provide raw material for insulation and building materials, biofuels and non-fossil energy generation.

Carbon dioxide equivalent (CO_2e)

Common name	Chem. formula	GWP
Carbon dioxide	CO_2	1
Methane	CH4	25
Nitrous oxides	N2O	298
Perfluorocarbons	PFC/FKW	6,500
Hydrofluorocarbons	H-FKW / HFC	11,700
Sulfur hexafluoride	SF6	23,900

Each of the six GHGs has different physical properties and propensities to absorb and re-emit infrared radiation. To provide a common measurement this is expressed as a carbon dioxide equivalent (or CO_2e) where 'equivalent' means having the same warming effect over 100 years. The global warming effect of CO_2 is taken as one, and all other gases are multiplied by their global warming potential (GWP is a measure of how much a given mass of GHG is estimated to contribute to global warming). One ton of CO_2 equivalent is abbreviated as "one tCO_2e," and one billion tons (1000 million tons) as "one $GtCO_2e$" or one gigaton.

Biogenic: Derived from biomass but excluding fossilized or from fossil sources.

Biogenic CO_2: From combustion of renewable biomass, crops or organic waste – this emission is considered to be carbon neutral because the carbon dioxide generated is exactly the amount that was bound from the atmosphere by photosynthesis.

Biomass: The total weight or volume in a given area or volume of material of biological origin.

Climate: Statistical description of the weather over several decades.

Climate change: Attributed directly or indirectly to human activity that alters the composition of the global atmosphere.

Carbon cycle: Exchange of carbon in various forms between the atmosphere, ocean, terrestrial biosphere and geological deposits.

Carbon dioxide equivalent (CO_2e): Allows the different properties of six defined GHGs to be expressed collectively as a carbon dioxide equivalent, 'equivalent' means having the same warming effect over 100 years.

Carbon footprint (CF): The total GHGs caused by an individual or organisation, event or product.

Carbon neutral: Term 'neutral' is confusing and should be avoided unless clearly defined. It can mean something that has no GHG emissions (extremely rare); or something with net zero GHG emissions after carbon offsets have been purchased to achieve neutrality – the term 'offset' is clearer.

Carbon offset: Mechanism for claiming a reduction in GHG emissions through the removal of, or preventing the release of, GHG emissions in a process unrelated to the product being assessed.

Carbon sequestration: Removal of carbon from the atmosphere.

Carbon storage/sinks: Retaining carbon of biogenic or atmospheric origin in a form other than as an atmospheric gas.

Consumable: Ancillary input necessary for a process but not a tangible part of the product. Fuel and energy inputs to the lifecycle of a product are not considered consumables.

Energy intensity: Ratio of energy consumption and economic or physical output. At national level, energy intensity is the ratio of total domestic primary energy consumption or final energy consumption to gross domestic product or physical output. (Energy = Power x Time / Power = Energy/Time).

Fossil CO_2: The off-gas from burning fossil fuels such as oil, coal or gas.

Global warming potential (GWP): A measure of how much a given mass of GHG is estimated to contribute to global warming.

Greenhouse gases (GHGs): The six gases defined by the Kyoto Protocol

Greenhouse gas protocol: A widely used standard for GHG emissions reporting and the reference for the development of Carbon Footprinting.

Primary activity data: Quantitative measurement of activity from a product's lifecycle that, when multiplied by an emission factor, determines the GHG emissions arising from a process.

Product Category Rules (PCRs): Defines the criteria for a specific product category and sets out the parameters for which environmental assessments can be made.

Renewable energy: Non-fossil energy sources that do not suffer from resource depletion — wind, solar, geothermal, wave, tidal, hydropower, biomass, landfill gas, sewage treatment plant gas and biogases.

Reuse: Any operation by which something is reused for the same purpose for which it was conceived.

Recovery: Where waste replaces other materials that would have been used to fulfil a particular function.

Recycling: Reprocessing of waste materials into products, materials or substances, either for the original or other purpose.

Source reduction: The design or specification of product that limits the amount of material entering the supply chain without affecting performance.

Secondary data: Data obtained from sources other than direct measurement of the processes included in the lifecycle of the product.

System boundary: Set of criteria specifying which unit processes are part of a product system.

Tonne of oil equivalent (toe): A unit of energy – the amount of energy released by burning one tonne of crude oil – the IEA and OECD define one toe to be equal to 41.868 GJ or 11.63 MWh. Conversion factors allow different sources of energy to be converted to toe as a single energy unit.

Use phase: That part of the lifecycle of a product that occurs between the transfer of the product to the consumer and the end of life of the product.

VOC: Volatile Organic Compounds, anthropogenic VOCs are regulated, especially for indoors where concentrations can be high. VOCs and GHGs have different definitions and scopes of regulation.

Standards & Specifications

There is a range of standards, specifications and industry application guidelines at national and international levels for Carbon Footprinting.

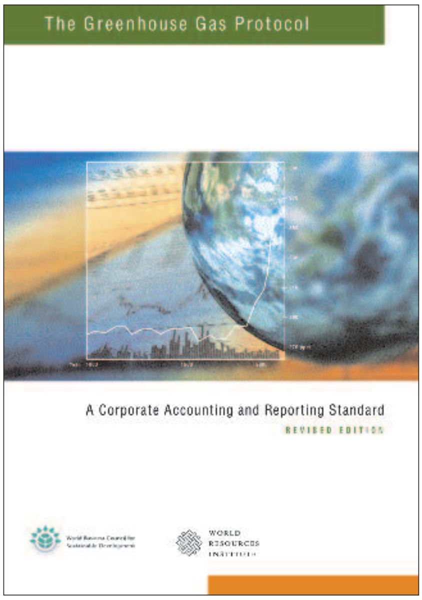
Standards

GHG Protocol: The origin of all reporting standards, labels, carbon calculators etc. The *Greenhouse Gas Protocol: A Corporate Accounting and Reporting Standard* was developed by the World Resources Institute and the World Business Council for Sustainable Development, was first published in 2001 and has been continually developed. Other standards have been derived from it. The objective of the Protocol is to simplify and systemise the complex process of collecting information, calculating and reporting of GHGs. Tools and application guidance is available as free download at www.ghgprotocol.org.

ISO 14064: Organisational Carbon Footprinting. Specification and organisation level guidance for quantification and reporting of GHG emissions and their reduction. ISO14069 is work in progress.

ISO 14040-14044: Environmental Management Systems and Lifecycle Assessment (LCA) guidance. EcoBalance is certified under ISO 14040-43.

ISO 14067: Draft due for publication in 2011/12 to specify the requirements to quantify and communicate GHG emissions associated with the whole lifecycle or specific stages of the lifecycle of goods and services. The objective is to promote the monitoring, reporting and tracking of progress in the mitigation of GHG emissions. The standard builds on existing environmental management, LCA guidance and assessment standards and relevant programmes and initiatives including PAS 2050. An ISO Working Group was set up in October 2010 to explore a harmonised carbon footprint calculation for printing within this standard's framework including Product Category Rules (PCRs).



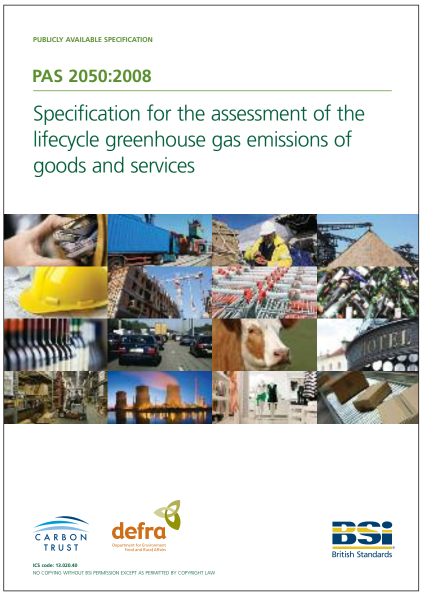
"The Greenhouse Gas Protocol: A Corporate Accounting and Reporting Standard" is the 'mother' reference for all reporting standards, labels, carbon calculators etc.

Proto-standards and specifications

France and the UK led European carbon measurement and reduction programmes. The French Bilan Carbone™ (carbon balance) is managed by l'Agence de l'Environnement et de la Maîtrise de l'Energie (ADEME). It is a detailed carbon measurement system for sites and territories including up and downstream emissions. The British Carbon Trust is an independent company set up in 2001 with the support of the UK Government. Its Carbon Management system allows the estimation (rather than measurement) of CO2 created from certain production stages.

PAS 2050 (Publicly Available Specification): Developed by the British Standards Institute and the Carbon Trust to calculate the carbon footprint of products over a 100-year life following the formation of the product, or less for shorter lifecycles. It includes the use and disposal of products.

PAS 2060: Specification for the demonstration of carbon neutrality to restore integrity to the concept by establishing clear and consistent requirements for demonstrating carbon neutrality. It builds on existing environmental standards and will lay down the requirements that must be met by any entity seeking to achieve and demonstrate carbon neutrality through the quantification, reduction and offsetting of GHG emissions from a uniquely identified subject.



PAS 2050 was developed in the UK by the British Standards Institute and the Carbon Trust to calculate the carbon footprint of products.

Industry guidelines

Intergraf recommendation for carbon footprint calculation: Released in 2010 with 13 identified parameters that in most cases are responsible for some 95% of CO2 emissions. Experience from Intergraf's Environmental Task Force, which included experts from France, Denmark, UK, Germany, Belgium, The Netherlands, and PrintCity, found that most of the current CF calculation approaches used in the industry have a high level of similarity with relatively low barriers to harmonisation.

CEPI 10 Toes: Confederation of European Paper Industries guidelines to making carbon footprint information more transparent.

Carbon labels

ADEME Product Footprint Project: French regulation for consumer environmental labels planned to be introduced in 2011 and includes Carbon Footprint. Working groups are preparing recommendations on 13 products groups, one of which directly concerns paper and printed products.

Carbon Reduction Label: UK Carbon Trust to showcase brands that are committed to reducing the environmental impact of their products.

Product Carbon Footprint Project: Project initiated by Öko-Institut for Applied Ecology, Potsdam Institute for Climate Impact Research and the Berlin-based think tank THEMA1. It aims to provide companies with practical joint experience on assessing and communicating Product Carbon Footprints.

The carbon & energy dynamic

The FCCC (Framework Convention on Climate Change) agreed certain basic principles, including:

- Remaining scientific uncertainties should not be used as a reason for inaction (the Precautionary Principle);
- Action should aim to stabilise atmospheric GHG concentrations at safe levels; and
- Action should be based on 'common but differentiated responsibilities' between countries and that industrialised countries should take the lead in tackling the problem.

The drivers

Environmental imperative

"Unless global warming is dealt with in the next 10-15 years it will lead to catastrophic consequences." (UN Intergovernmental Panel on Climate Change (IPCC) 2007 report). The primary cause of global warming leading to climate change is greenhouse gases (GHG) produced by a wide range of human activities, including energy generation, agriculture, transport, and sewage treatment.

There is a direct correlation between CO_2 fossil emissions, energy generation and consumption. Climate change is global in nature and only coordinated international actions can resolve it. Climate change is linked with resource use, waste disposal and pollution within sustainable development. Therefore, any single dimension (such as the carbon footprint) is an inadequate basis on which to make balanced environmental decisions.

Geo-political & legislative drivers

Climate change is probably the single largest defining factor for all levels of society in the 21st century and will occupy a central place in global geo-politics. This is driven both by the urgency of the issue and also because the subject now has widespread public awareness to which politicians must respond.

Governments established the IPCC in 1988 to help them understand the problem and build some international consensus around it. The IPCC's first report in 1990 confirmed the basic scientific cause for concern and recommended that countries should negotiate an international treaty to start combating the problem. This emerged as the UN Framework Convention on Climate Change (FCCC) signed at the Rio Earth Summit in 1992.

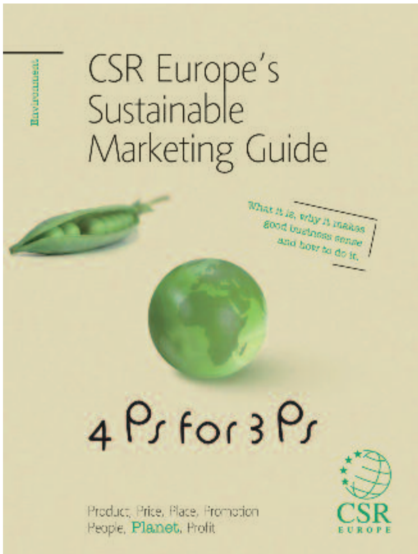
The Kyoto Protocol, which came into force in 2005, defines legally binding targets and deadlines for reducing to 1990 levels the GHG emissions of the industrialised countries that ratified the Protocol. The (then) 15 members of the EU ratified the Protocol in 2002, under which the EU was given a single emissions reduction target of 8% on average from 2008-2012 from a 1990 baseline – a Burden Sharing Agreement within the EU allocates targets between member states. Other provisions of the Kyoto Protocol encourage rich countries to finance carbon reduction projects in the developing world in exchange for carbon credits that can be counted against developed country carbon-reduction targets. Tools implemented by the UN include Certified Emission Reductions (CER), Clean Development Mechanisms (CDM), Emission Reduction Unit (ERU), Verified Emission Reduction (VER) and Joint Implementation (JI). The EU has taken a leadership position on implementing both the Kyoto treaty and post-Kyoto agreements: for example, the introduction of the first carbon cap and trade system in 2005, and in December 2008 the 20/20/20 mandatory reduction targets by 2020 (20% reduction of GHGs / 20% increase in energy efficiency / 20% increase of renewable energy sources).

The Kyoto treaty expires in 2012. Major emission producers who had not implemented Kyoto – such as the USA, China, India and Brazil – are now more engaged with carbon reduction and are participating in negotiations to replace the treaty. The successful 2010 Cancun UN environmental conference established new agreements including the recognition of industrialised country targets for low carbon strategies; registration and reporting of developing countries mitigation activities; establishing a Green Climate Fund of $100 billion to support developing world climate action; improved Clean Development Mechanisms; reduced deforestation and forest degradation; and increased technology cooperation.

Economic drivers

The Stern Report on the Economics of Climate Change found that addressing global warming by cutting emissions will cost about 1% of the world's GDP and that doing nothing will cost 5 to 20 times more. A more recent IPCC report identifies that the most stringent mitigation target would reduce global growth by 0.12% per year to 2050; it could be less.

CSR Europe's 'Sustainable Marketing Guide' describes a structured approach of Product, Price, Place, Promotion + People, Planet, Profit.



The Carbon Trust / McKinsey & Co 2008 report *"Climate change – a business revolution?"* reviews some implications on investment decisions. "Today, investment and business decisions do not put us on a path to a low carbon economy. They appear to be in line with greenhouse gas concentrations rising to more than 700ppm (parts per million) CO_2e compared to a target of less than 550ppm CO_2e.

- Tackling climate change could create opportunities for a company to increase its value by up to 80% if it is well positioned and proactive. Conversely, it could threaten up to 65% of value if the company is poorly positioned or a laggard. The scale of the opportunities and threats analysed within six sectors that total approximately $7 trillion in market capitalisation are therefore very significant for investors and business managers.
- The opportunities and risks are driven by shifts in consumer behaviour, technology innovation and regulation. Regulation is usually the key initiator of change although the cost of carbon is not the decisive factor in many sectors.
- The impact of tackling climate change will, therefore, vary by sector. Four ways in which value could be created or destroyed: sector transformation, upward or downward demand shift, and increased volatility.

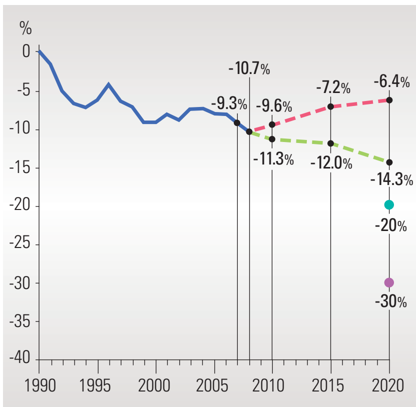
'Pulp and Paper is responsible for less than 1% of total GHG emissions in Europe, and these have dropped by 8% since 1990, while production has increased by around 12%'.

Business & marketing drivers — people, planet, profit

"As the global community struggles with the issues of over population, increasing energy demands, loss of biodiversity and the wide ranging impacts of climate change, the sustainability issue is now a priority across boundaries – political, cultural and professional. Sustainability is fast becoming the most critical business issue since industrialisation. In a business context, sustainable development means taking a triple bottom line approach so that the business measures its success not just on financial performance, but on its environmental and social performance too." – CSR Europe's *Sustainable Marketing Guide* (which explains a structured approach of Product, Price, Place, Promotion + People, Planet, Profit).

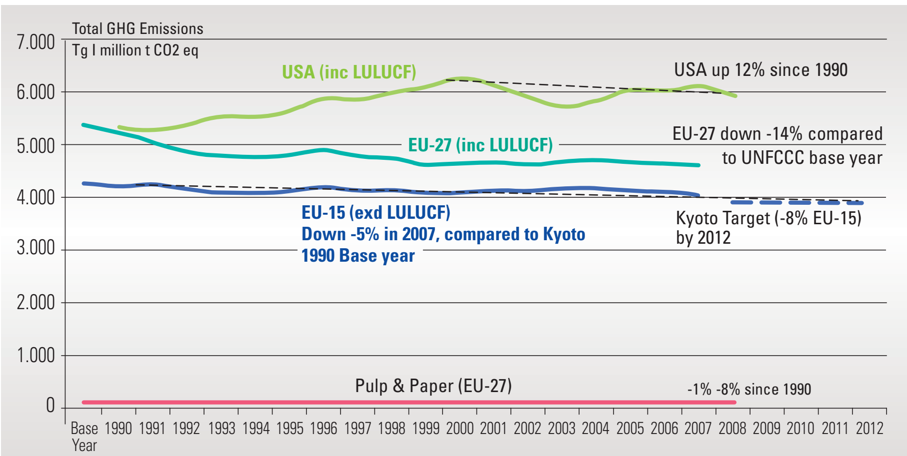
Research from the UK's Carbon Trust in 2009 shows that 63% of consumers are more likely to buy a product if they know action is being taken to reduce its carbon footprint, and 70% want businesses to do more to help them make more informed environmental choices about the products they buy. Committing to reduce a product's carbon footprint has a positive impact on the brand's reputation as 58% of consumers say they value companies that are taking action to reduce their carbon emissions. Environmentally responsible brands must shout louder – only 12% of consumers think that companies are doing enough to cut carbon emissions and tackle climate change.

In this context, buyers are asking for the carbon footprint associated with the supply chain for the manufacture, distribution and disposal of products supplied to them. Customers want a simple statement and the guarantee that it is accurate. However, there is a complexity of facts, philosophies and models to calculate a carbon footprint. This is partly due to an initial series of uncoordinated national and commercial initiatives (Wal Mart, Tesco, Casino, etc). There are a number of national and international initiatives to establish guidelines and standards including ISO 14040/14044, UK PAS 2050 guidelines, ISO 14067 due for release in 2012, et al.



The EU-27 is making good progress towards its 2020 emission reduction target of -20% and the implementation of planned additional measures is expected to bring domestic emissions down to 14% below 1990 levels.

Source EEA report N°9/2009/Sun Chemical

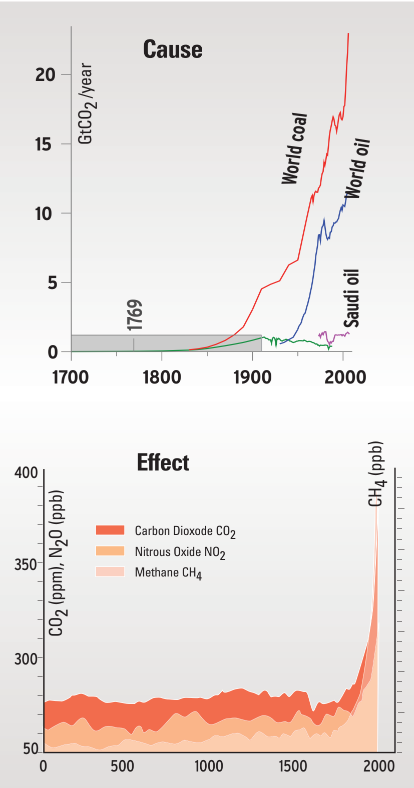


This EMGE chart shows the relative progress of the US and EU and Kyoto targets "The European Environmental Agency estimates that in 2008 emissions from the EU-15 member states fell further, to 5.2% average below their levels in the base year, EU-27 emissions are now estimated to be 13.6% lower than the base year level." EU Press Release November 12, 2009. Pulp and Paper is responsible for less than 1% of total GHG emissions in Europe, and these have dropped by 8% since 1990, while production has increase by around 12%. (LULUCF = Land Use Land Use Change & Forestry).

Sources unfccc / eea.europa.eu / CEPI / EMGE & Co.

'In terms of CO_2 emissions, coal is still king'.

Sustainable Energy – Without the Hot Air



The industrial revolution drove carbon extraction and combustion, with its subsequent effect on the climate. From 1769 to 2006, world annual coal production increased 800-fold and is still increasing today. While other fossil fuels are extracted too – the right graph shows oil production – in terms of CO_2 emissions, coal is still king.

Source Sustainable Energy – Without the Hot Air

The issues

The greenhouse effect?

The greenhouse effect occurs where some of the infrared radiation emitted by the Earth's surfaces that would normally escape into space is instead absorbed by GHGs in the atmosphere and then re-emitted in all directions. As the amount of GHGs increases in the upper atmosphere so does the amount of heat prevented from escaping the earth, the effect being to warm the earth's surface and lower atmosphere… leading to global warming.

The Kyoto treaty identifies six greenhouse gases – carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulphur hexafluoride (SF_6). Water vapour absorbs infrared radiation but is not considered to be a cause of man-made global warming because it does not persist in the atmosphere for more than a few days; however, it acts as an accelerator of the effect – dust has a similar effect. VOCs (Volatile Organic Components) and GHGs have different definitions and scope of application.

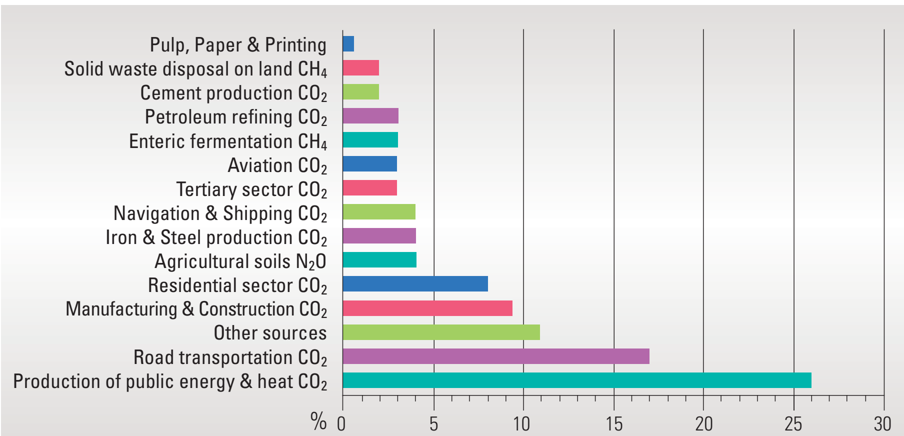
"In 2000, the world's GHG emissions were about 34 billion tonnes of CO_2e per year, or a planet per capita average of about 5.5 tonnes CO_2e. However, the output per capita is highly variable by country: 20-24 tonnes CO_2e for Australia, USA and Canada; and 8-12 tonnes CO_2e for Europe and Japan. While China's total emissions are similar to the USA's, their per capita emissions are below average, while India's are less than half the world average – much of their industrial emissions are associated with the manufacture of goods for countries with above average CO_2 consumption.

"To avoid a risk of giving the earth a 2°C temperature rise we need to reduce the cause rapidly. Some countries, have committed to at least a 60% reduction in GHG emissions by 2050. However, if the world's emissions are only gradually reduced, then climate scientists believe it's more likely, than not, that global temperatures will rise by more than 2°C. The possibly safe trajectories require global emissions to fall by 70% or 85% by 2050." *Sustainable Energy – Without the Hot Air 2009.*

Sources of GHGs

A wide range of human activities, including energy generation, agriculture, transport, and sewage treatment, generates GHGs. There is a significant correlation between CO_2 emissions and fossil fuel energy consumption which has the largest single greenhouse effect.

"While there are very large natural flows of CO_2 in the atmosphere and ocean, these have been constant over the last few thousand years and cancel themselves out. The problem comes from the additional flow switched on 200 years ago when fossil fuels became the energy source for the Industrial Revolution. Coal was used to make iron, build ships, to heat buildings, to power locomotives and other machinery, including pumps that enabled more coal to be mined. From 1769 to 2006, world annual coal production increased 800-fold and is still increasing today. Other fossil fuels like oil are being extracted too but, in terms of CO_2 emissions, coal is still king." *Sustainable Energy – Without the Hot Air.* (Currently, Europe generates 29% of its electricity from coal, the US 50%, India 68%, and China 75% – Eurocoal, IFP, IEA).



Pulp, Paper & Printing is very small contributor (0.6%) of total European emissions (it is normally classed with manufacturing & construction).

Source EEA 2009/Sun Chemical

Why is energy policy important?

There are three realities concerning energy that impact on all users:

- Conventional energy supply is limited and it will be expensive = lower consumption
- The cheapest kW of energy is the one not used = improved energy efficiency
- Significant reduction of fossil fuelled energy = cleaner generation

The energy challenge is not just the 60-80% reduction in GHGs by 2050 from 1990 levels in developed countries but also that world population is predicted to increase by about 50% in this period, and that many countries are moving to more developed economies with a consequent increase in demand for energy, e.g. total energy use in China doubled from 1990 to 2006 and is expected to double again by 2025.

Three different motivations drive today's energy discussions *('Sustainable Energy - Without the Hot Air'):*

1. Fossil fuels are a finite resource. So we seek alternative energy sources. Indeed given that fossil fuels are a valuable resource, useful for manufacture of plastics and all sorts of other creative stuff, perhaps we should save them for better uses than simply setting fire to them.

2. We're interested in security of energy supply. Even if fossil fuels are still available somewhere in the world, perhaps we don't want to depend on them if that would make our economy vulnerable.

3. It's very probable that using fossil fuels changes the climate. And the main reason we burn fossil fuels is for energy.

"So to fix climate change, we need to sort out a new way of producing energy. The climate problem is mostly an energy problem. The first two concerns are straightforward selfish motivations for drastically reducing fossil fuel use. The third concern, climate change, is a more altruistic motivation – the brunt of climate change will be borne not by us but by future generations."

"The four trends that will shape the world's energy system this century: electrification, decarbonisation, localisation and optimisation," states the *Financial Times, Future of Energy*, 11/2009. Clear government energy policy is essential for companies investing in new power stations that can have an ROI of around 30 years. Currently, the lowest cost fuel sources are usually coal or gas. If coal carbon capture works and becomes an obligation it will have the effect of doubling the investment required for a coal-fired power station and increasing the cost of electricity. This may then make other forms of energy generation more commercially viable. A similar effect would be produced by carbon trading applied to all fossil fuel generation. Other energy mix solutions will include micro-generation of electricity from non-fossil fuels using solar, wind and CHP units that are then linked back to smart distribution grids.

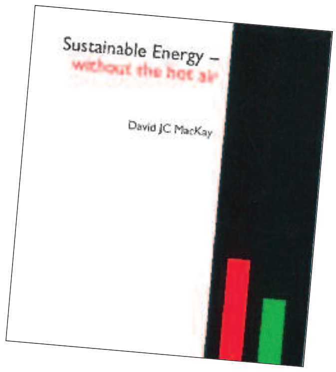
In the short term, improved energy efficiency is the fastest and cheapest way to reduce CO_2 because investment in available technologies would cut carbon emissions by about half of the amount needed to stabilise them. The McKinsey Global Institute concluded in 2007 that investment in energy efficiency of about $170bn a year worldwide would yield a profit of about 17%. "The Energy-Efficiency Opportunity" by Diana Farrell and Jaana Remes, McKinsey Global Institute for The Climate Group 2008 concludes that:

- Without a change in energy policies and consumption behaviour, global energy demand and energy-related CO_2 emissions will grow by 45% to 2020.
- There is potential to cut the projected energy demand growth by two thirds – from 2.2% to 0.7% per annum by adopting energy efficiency improvements using existing technologies to generate an internal rate of return of 10% or more.
- Boosting energy efficiency is the most economic way to reduce GHG emissions, representing over two thirds of all available negative cost opportunities.

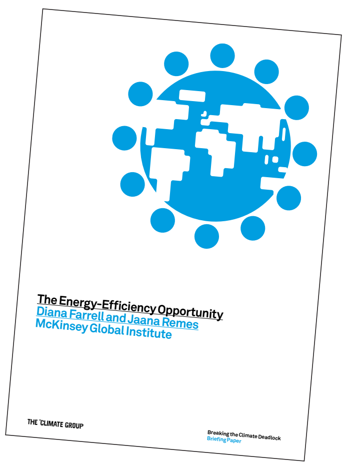
One of the ways to increase energy efficiency is to introduce 'smart' distribution grids that use digital technology and the internet to interacts with electrical appliances to improve energy efficiency, reduce cost, increase reliability and transparency.

'Four trends that will shape the world's energy system this century are electrification, decarbonisation, localisation and optimisation'.

Financial Times



"Sustainable Energy – Without the Hot Air" is a clear guide for anyone seeking a deeper understanding of the real problems involved. Its author, David MacKay FRS, is a Professor in the Department of Physics at the University of Cambridge and a member of the World Economic Forum Global Agenda Council on Climate Change. The electronic version of his book is available free from www.withouthotair.com.



'Breaking the Climate Deadlock' is an initiative of former UK Prime Minister Tony Blair and The Climate Group NGO to build political support for a post-2012 international climate change agreement.

'Be aware of the complexity of Carbon Footprints and possible differences due to chosen scope, assumptions, and default factors used'.

The Carbon Responses

Carbon Footprinting is an evaluation tool

The objective of Carbon Footprinting is to measure the GHG emissions of a business, production site, product, or service. The primary reason to do this is to drive steps to reduce GHG emissions and fossil energy use. A secondary reason is to act as a base for carbon compensation and communication. Caution: the inappropriate use of Carbon Footprinting as a single parameter to compare goods or services can lead to unbalanced environmental decisions. There is no single universally accepted definition. The one chosen for this report is:

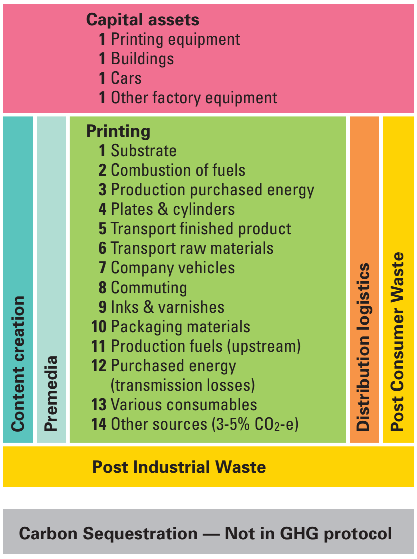
The Carbon Footprint is the total amount of fossil carbon dioxide (CO_2) and other GHGs emitted over the full lifecycle of a product, process, company, location or service. Normally, a Carbon Footprint is expressed as a CO_2 equivalent (mass of CO_2-e) - *see page 15.*

"The Greenhouse Gas Protocol: A Corporate Accounting and Reporting Standard" sets the Carbon Footprinting approach. The definition of operational boundaries describes at three levels the extent to which emissions will be analysed:

Scope 1: Measures ***only the emissions from the direct activities*** of equipment owned or controlled by a company.

Scope 2: Accounts for emissions from the production of purchased energy. ***The energy source is important as fossil energy generation has a high GHG impact, while sustainable and nuclear have the lowest. The use of European or national factor averages will make a difference to results.*** How to calculate energy mix, averages or site specific, national or European factors. National fuel mixes are a problem. Preference is for a single figure for average energy in EC.

Scope 3: Optional calculation of 'embodied emissions' from the activities of a company and also from external sources, e.g. created from manufacturing, materials and services purchased, logistics, employee commuting, etc. Not everything has to be included – but it is essential to define what is excluded and why, and where estimates are used. Embodied emissions in the supply chain are the most comprehensive and there is a growing trend to measure them. ***The definition of boundaries is often the largest source of incompatibility, confusion and concerns about precision of data.***



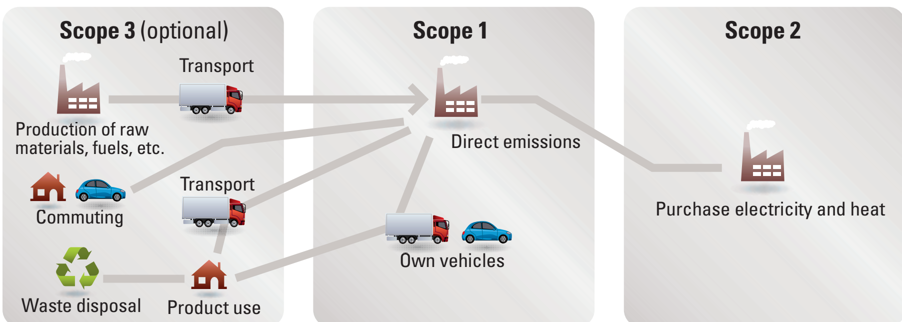
Defining the boundaries between the links in the graphics industry value chain are prerequisites to an efficient and modular approach.
Graphic PrintCity

Common definition of boundaries across the supply chain is essential to avoid non-productive collection of non-standard data, and allow a holistic approach to minimising GHG emissions and energy use across the entire supply chain.

Political administrations are increasingly looking at standards, labels and other instruments relevant to consumers to involve them in climate change mitigation. Therefore, attention goes beyond carbon emissions of production activities, companies or sectors, and is also focussing on emissions associated with products.

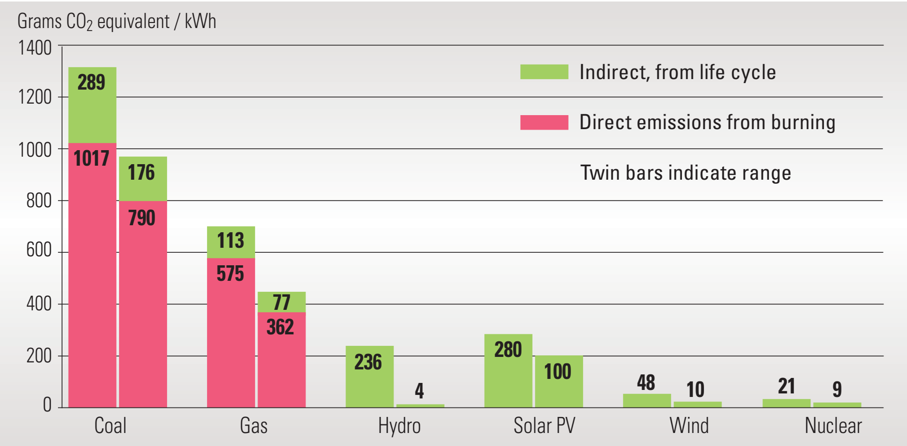
Emissions are not yet reported consistently, clearly and with transparency which has created barrier to direct comparability. Some use absolute emissions and others emissions intensity (e.g. relative to production, or sales). Be aware of the complexity of the Carbon Footprints and possible differences due to chosen scope, assumptions, and default factors used. If Carbon Footprints are used to compare products or suppliers, they must use the same system boundaries, the same percentage of coverage of the total lifecycle emissions (cut-off criteria) and similar standards (calculation methods).

Avoided emissions are currently not covered (in PAS or ISO) and represent a sliding scale of creativity and credibility.



'The Greenhouse Gas Protocol: A Corporate Accounting and Reporting Standard' defines the principal implementation steps and where to set the boundaries and what will be included, excluded, and reported. The organisation boundary defines which parts of a company, group, subsidiaries, joint venture, etc. are concerned; and the operational boundary's three scope levels define the depth at which emissions will be analysed.
Graphic Association Denmark (GA)

How 'green' is the energy footprint?



Greenhouse gas emissions from electricity production
"All fuels consume some energy in their production and consequently cause some GHG emissions." Source IAEA 2000

'Carbon Footprints using national average electricity factors are no longer a clear guide to what energy mix is actually being used'.

One of the major challenges faced in defining the Carbon Footprint is what factor to use in converting energy measurements into CO_2e (Scope 2 GHG Protocol). The fuel used for electricity generation can vary significantly between countries, e.g. from predominantly coal electricity generation (Poland, Greece, Germany, Holland, Italy and UK) that has much higher CO_2 emissions than in countries like France, the Scandinavian countries, and Switzerland where there is a very high level of renewable and/or nuclear energy. In this report nuclear energy is only considered on its GHG performance, however, its use has different levels of acceptability in different parts of the world due to its other environmental risks and aspects.

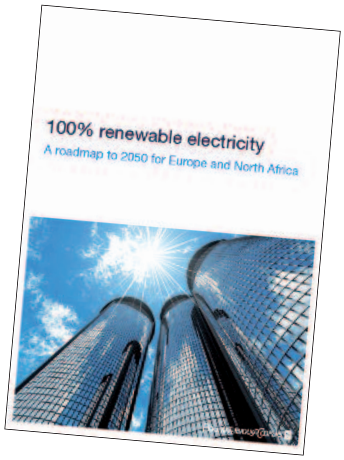
However, electricity distribution in Europe has now been decoupled from generation to allow competing energy generators (and fuels) to supply across borders. This means that Carbon Footprints using national average electricity factors are no longer a clear guide to what energy mix is actually being used, and in some cases can be misleading. For example, a manufacturer with very poor energy efficiency using predominantly non-fossil fuel energy could have a much lower Carbon Footprint than an ultra-efficient company doing the same work but using energy derived predominantly from fossil fuel; or a company in a 'low carbon' country will have a superficially low Carbon Footprint, but may, in reality, source energy from a country using fossil fuel generated electricity. In some countries part of the electricity from renewable energy sources might already be sold/exported as green electricity, and should thus be excluded from the mix to avoid double counting.

Subsequently, there is a strong point of view that using a common European average conversion factor more appropriately reflects the open energy market and would eliminate distortions and the risk of double counting of carbon benefits from national energy averages. The average European CO_2 factor is ca. 400g CO_2e/kWh (UCTE). The EU-Ecolabel criteria for graphic and copying paper also use this factor.

The energy profile used has significant impact on results and should be stated in calculations results and scope.

In some cases, 'green' energy may not be available and insistence on its use can be environmentally counter-productive. An example is virgin newsprint manufactured in Scandinavia using non-fossil fuel energy, and exported for use in the UK, where it has a lower Carbon Footprint/tonne than local made newsprint using 100% recycled paper but using mostly fossil fuel energy. A simple national carbon footprint approach can undermine waste recovery and recycling systems and have an overall detrimental impact on global GHG emissions, not the least of which would be the lack of support for reducing organic waste to landfill. This example illustrates the point that Carbon Footprint and the reduction of GHG are but one element of overall environmental considerations.

The mix of energy types is a crucial factor in the final result. Most electric utilities will offer a range of different types of energy generation and this is an essential element to communicate if the final energy calculation is to have any sense.



'100% renewable electricity – A roadmap to 2050 for Europe and North Africa' *2010 Report by Pricewater-houseCoopers, Potsdam Institute for Climate Impact Research, International Institute for Applied Systems Analysis, and the European Climate Forum (ECF) Available online at: www.pwc.com/climateready*

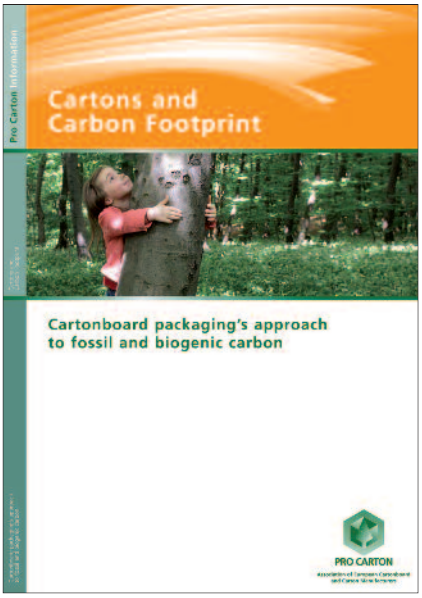
Total energy measurement

An energy strategy that only takes the carbon factor into account is simplistic because the footprint is significantly influenced by the source of energy used. By switching to a lower carbon energy source, the overall carbon footprint can be reduced but the amount of energy required remains unchanged.

For those companies seriously interested in reducing their overall energy consumption, the measurement of the total energy used is essential. The most suitable single unit of energy to use is the Tonne Oil Equivalent (toe), which is the amount of energy released by burning one tonne of crude oil – the IEA and OECD define one toe to be equal to 41.87 GJ or 11.63 MWh. Conversion factors allow different sources of energy to be converted to toe as a single energy unit.

'Carbon sequestration through forestry and the carbon fixed and stored in archived paper and wood products offer potentially significant sequestration opportunities'.

Guardian, 28 December 2007



'Cartons and Carbon Footprint, Cartonboard packaging's approach to fossil and biogenic carbon' 2010, Pro Carton.

Other carbon dimensions

Carbon sequestration

Carbon sequestration is the long term storage of CO_2 captured from the atmosphere through biological, chemical or physical processes and then stored either in biological matter, as products, or carbon storage reservoirs such as aquifers and aging oil fields.

Sequestration currently lacks agreed standards and calculation methods, and opinions differ as to its role in reducing GHG emissions. There is no consensus on the timescales involved for long term climate change mitigation – how long would carbon need to be 'locked-away' for it to be considered sequestered? There are also concerns that many of the physical and chemical means of capturing and storing carbon would themselves require energy to operate, and that the capture of carbon directly from fossil fuel using some processes would simply slow down the global switch to renewable alternatives.

Carbon sequestration through forestry and the carbon fixed and stored in archived paper and wood products offer potentially significant sequestration opportunities that do not suffer from these concerns and which offer a significant (positive) offsetting potential (for a period of 30 years). A study by Pro Carton / IVL in 2009 developed a methodology to assess biogenic carbon and end-of-life emissions in the lifecycle of cartons.

Different sequestration approaches include:

Ocean sequestration: One concept is to use microscopic phytoplankton plants near the sea surface to absorb more CO_2 from the atmosphere and store it in the ocean's interior; however, there are major concerns about the impact on marine ecology. Another approach is to inject liquid CO2 into the ocean at a depth of 1500 to 3000 metres, but there is a great deal of uncertainty about the permanence, stability and impact of carbon stored in the deep ocean.

Geological sequestration: Compressed CO_2 from power plant exhausts can be stored in old oil wells at sea, deep deposits of briny water or depleted natural gas fields. The Norwegian energy company Statoil has used the technique in the North Sea since 1996 as part of a European research project.

Forest sequestration: Biological sequestration of carbon in plants and soils may have the greatest impact over the next few decades. The world's forests represent an important carbon sink and, just as deforestation can reduce this sink, so afforestation can be used to increase the sink and is encouraged under the Kyoto Protocol. However, planting more trees should not be seen as the solution to increasing atmospheric CO_2. Forests are only sinks when expanding, and trees uptake carbon in their first 20-50 years depending on species and site conditions. Forest decay and fires may turn forests into a global source of carbon. Substantially, increased forest areas could alter the mean global reflectivity of the land surface (Albedo) and lead to more radiation being absorbed and warming up the earth. The soil carbon stock capacity is greater than the carbon stored in vegetation and, consequently, soil conservation is important for minimising the oxidation (caused, for example, by soil erosion or ploughing) and subsequent emission of soil carbon to the atmosphere. Sustainable forest management is an essential tool to optimise forest GHG sequestration.

Forest product sequestration: Products made from solid wood, wood fibre or substances produced from wood can sequester carbon if the product is stored or archived for a significant period of time. This includes the use of timber in buildings and furniture, the long term storage of paper archives or libraries. PAS 2050 allows for full sequestration to be claimed for storage of forests products exceeding 99 years, and part sequestration for shorter periods.

Carbon neutral & offsets

The term carbon neutral is confusing and should be avoided unless clearly defined. It can have different meanings in different countries. It can mean a product or service that truly has no GHG emissions (extremely rare) or something having net zero GHG emissions after carbon offsets have been purchased to achieve neutrality; in some countries it is associated with commercial offset services.

A carbon offset is a financial instrument representing a reduction or avoidance of GHG emissions. Offsets are measured in metric tons of CO_2e. All commercial/industrial activities and processes generate GHG emissions. The only way to limit global warming is reduction of GHG – it is the CO_2e not emitted that counts. Only after all avenues of reduction have been exploited does compensation from carbon offset have a role to play.

Carbon offsets allow a company to negate the creation of its carbon by avoiding the release, or removing from the atmosphere, the same amount of carbon somewhere else. The Kyoto treaty mandates that this must be "…real, verifiable, and additional to what otherwise would have occurred." Examples include: methane destruction by farms and landfills to earn offsets by using digesters to collect and destroy methane; agricultural practices to earn offsets including planting grass and trees, and by collecting methane from manure; forest enrichment and conservation projects, and planting of trees in urban areas; renewable energy projects like wind, solar, hydropower, and biofuel systems to earn offsets based on the amount of energy supplied to the grid that replaces carbon emitting generation.

"Some people compare carbon offsets to 'indulgences' granted by the church allowing sinners to avoid punishment for some transgressions. Others argue that offsets can be one of many legitimate tools used to tackle climate change, and that high quality carbon offsets can result in real reductions in GHG emissions. Carbon offsets that are real, additional, and permanent can have a direct, positive impact on the climate. They provide money for much needed renewable energy and energy efficiency projects, which can help move society away from fossil fuels and toward a clean energy economy. Buying carbon offsets can also help to deal with emissions that are not currently covered by government regulations, such as international air travel. Carbon offsets put a value on carbon, and help to educate businesses and consumers about the climate impact of their daily decisions, and where they should target their own reduction efforts." *David Suzuki Foundation 2009*

Whatever the view of offsetting, it is generally agreed that its role is secondary to that of direct reduction in GHG emissions and should be seen as a tool to be used where all other avenues have been exhausted. It is also important to remember that it is past emissions that are offset by actions that take effect in the future – so there is a delay factor.

Carbon trading

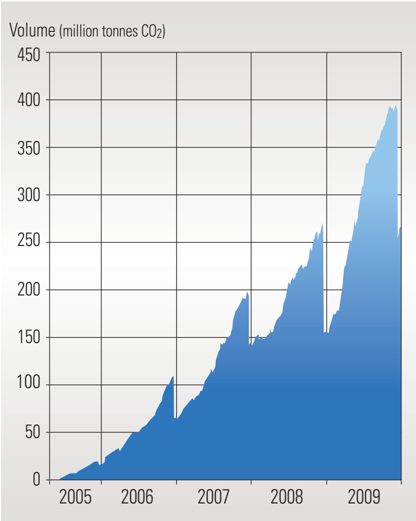
There are two primary markets for trading in carbon credits/allowances to offset others emissions. In the larger and regulated compliance market, companies, governments or other entities buy carbon credits in order to comply with caps on the total amount of carbon dioxide they are allowed to emit. In the smaller voluntary market, individuals, companies, or governments purchase carbon offsets to mitigate their own greenhouse gas emissions from transportation, electricity use, and other sources. These voluntary instruments cannot be used to meet obligations in the regulated compliance market.

The European Union Emission Trading Scheme (EUETS) is one of the most significant measures of the EU climate policy. Introduced in 2005, it covers six energy intensive industry sectors including electricity generation, manufacture of steel, cement, glass, pulp and paper. Industrial installations obliged to participate represent about 40% of total EU GHG emissions. From 2008 large EU publication gravure plants are included in this scheme and from 2012 large heatset printers will also be covered. Permits for carbon emissions can be traded on regulated markets to ensure their net reduction. Credits can be purchased to allow for expansion. Companies that reduce emissions gain credits to sell as offsets or to hold for future expansion. The maximum emissions can be capped at or below the current permitted level. As the cost of allowances increases so does the economic incentive for remedial action at source. Until 2012, the industries covered receive only slightly fewer permits than they need to operate; from 2013 the volume of allowances will be reduced below the level required to operate at current levels of emissions, and these allowances will increasingly be distributed by auction rather than by free allocation. To be effective, carbon (in the form of credits/offsets/allowances) needs to be traded at a price level that will generate change in energy use and GHG emissions. This is variously estimated at 30-50 €/tonne whereas the 2009 ETS price was around 15 €. The UN's target for a CO_2 trading price is U$20-25 (17-21 €/tonne by 2020 to finance environmental change.

The new UK Carbon Reduction Commitment (CRC) is targeted at users not currently affected by regulation that consume more than 6000 MWh of electricity annually. They will have to buy and surrender carbon allowances to cover their annual emissions; revenue from the sale of allowances will be recycled back to participants based on their carbon cutting performance. The goal is to reduce the carbon emissions of these UK organisations by around 1.2 million tonnes of CO_2 per year by 2020. The scheme will work in tandem with existing EUETS and Climate Change Agreements.

The US has a functioning mandatory carbon trading systems in several states, the Region GHG Initiative (RGGI), that includes energy generators. Japan has a voluntary experimental scheme and other countries are developing schemes.

'Carbon offsets allow a company to negate the creation of its carbon by avoiding the release, or removing from the atmosphere, the same amount of carbon somewhere else'.

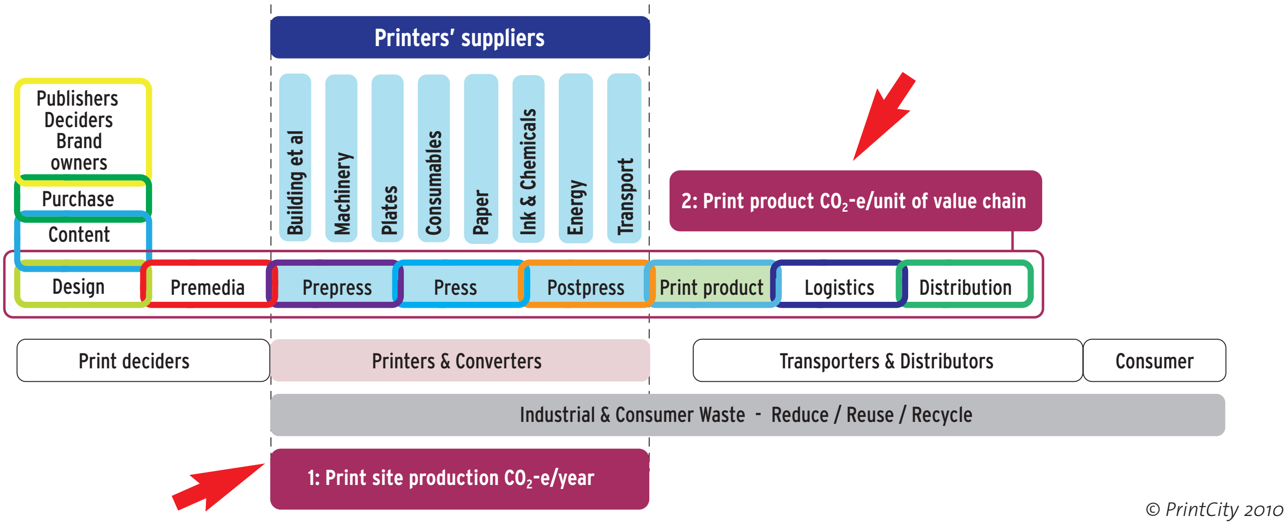


Economic incentives are an essential driver to a lower carbon society. This chart shows the progressive increase of trading of millions of tonnes of CO_2 permits.

Source ECX EUA Futures Contracts

Carbon impact on print as a media and for packaging

Carbon Footprint value chain — making it 'leaner and greener'



'The term 'dead tree edition', long used jokingly by new media types, implies an assumption that digital media is inherently more environmentally-friendly than print. That assumption is deeply flawed and needs to be challenged'.

Guardian, 28 December 2007

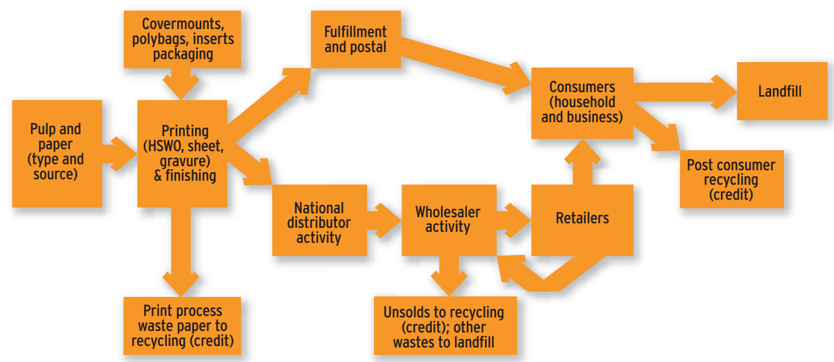
Publication and commercial printed products have similar value streams. However, publications can have a higher proportion of overall CO_2e and energy consumption due to transport that includes the return of unsold copies. The consumer is an important link in the chain not only through its purchase and use, but also how it is recycled or otherwise disposed of. Waste is a part of the value stream but can be difficult to integrate into carbon and energy consumption calculations.

Mapping of Value/Process Streams identifies the multiple sources of CO_2e and energy consumption. The most effective optimisation approach is to work across the entire value stream to measure, identify and prioritise areas where improvements can be made. Anything that makes the supply chain more energy efficient generally saves carbon. This approach can use techniques from Lean Manufacturing, Six Sigma and Lifecycle Analysis. Industry is driven by the need to reduce total production costs whilst becoming more environmentally efficient. In this context **'Lean and Green'** (Environmental and Lean Manufacturing) frequently functions inclusively to improve both environmental and business performance.

The carbon reduction objective can facilitate the transformation of simple supplier/customer relationships to one where common projects are defined that can last several years with more durable contractual relations. For example, the reduction of the carbon footprint of a magazine requires all participants in the supply chain to work together – the publisher, paper maker, printer and distributor. Within this approach carbon reduction objectives can be shared. For example, a bank sets the objective to reduce its carbon footprint by 15% over five years. An initial simplistic solution could be to reduce all of its supplies by 15%, including printing. A more favourable solution would be for a printer to share the same objective without a reduction in printing volume but with a 15% reduction in the carbon emissions generated from it. In some cases, the optimisation of transport to reduce carbon may lead to more distributed printing. This will require a case-by-case evaluation, particularly the origin of the paper used at the different locations. Correctly used, carbon management presents environmental, economic and commercial advantages. It is a strategic tool for companies to provide them with a clearer vision of the future.

"The Facts of our Value Chain" 2009 is an excellent reference for facts and arguments for mail media published by the European Mail Industry Platform.

Carbon impact on print & electronic media



The magazine value and process chain was evaluated by the Periodical Publishing Association to calculate the carbon footprint for the UK magazine publishing sector. The results showed that 55% of the industry's carbon footprint came from pulp and paper making, 3% from transporting paper from the mill to the printer, 30% from printing, 8% from cover mounts and packaging, 4% from distribution and 1% from post-consumer landfill. Unsolds accounted for 24% of the overall. The results have stimulated GHG reduction measures.

Source PPA

Both paper and electronic media have a place in a sustainable future and the question is not which medium is environmentally preferable but, rather, how both platforms can work together to reduce the overall environmental burden. Unfortunately, electronic media are frequently perceived as being environmentally better than print – perceptions that are in many cases erroneous or incomplete, with brand owners and advertising agencies making decisions on the use of print based on an incomplete environmental picture.

Sections of the electronic media and their suppliers are positioning themselves as being more environmentally friendly than print – a mantra so effectively communicated that it is often considered to be 'fact' by many consumers, businesses and politicians.

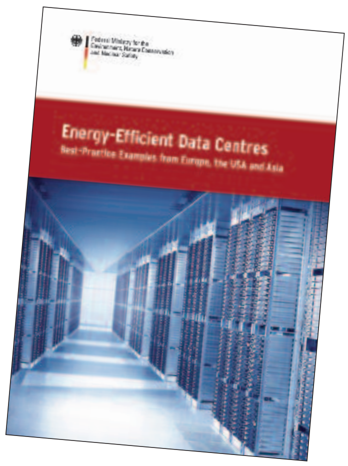
What is rarely communicated is that the energy demand of electronic media and its carbon footprint is several times greater than of ink-on-paper. Pulp, paper and printing accounts for about 0.6% of GHG emissions in Europe (EEA data) and an estimated 1-1.5% of global energy. On the other hand, Internet data centres are forecast to use around 4% of global energy consumption in 2010, double its 2% use in 2006 (Gartner). Excluded from this figure are TV, mobile phones and other electronic media devices. A German Federal government report estimated that ICT (information and communication technology) took 10,5% of the country's electricity consumption in 2007. The Freiburg Öko Institut estimated that, in 2005, about 20 giant power stations were necessary just to run the Internet for about 1.5 billion people who had access to the Internet then. Internet use will continue to grow strongly from new users, higher volume data use for video and film downloads, and from Cloud computing.

"The energy footprint of the entire Internet is much more than data centres – it includes the devices we consume the Internet on (computers, mobile phones, mp3 players) and the telephone exchanges that deliver information. Given this wide variety of places where energy is spent, there are few clear-cut studies that show how much the Internet as a whole consumes. The clearest possible outline was published in 2007 by the Climate Group and focuses on CO_2. The report suggests that by 2020, the Internet's footprint will have tripled to 1.43bn tonnes of carbon emitted per year, largely thanks to increasing use of PCs and mobile phones, and driven by exploding economies such as China and India. However, it also suggests that improvements made possible by information technology – such as smart logistics, energy-aware buildings and more efficient energy grids – could reduce emissions by 15% overall". *Guardian 2008*

In 2007, a Gartner Group report warned about the "carbon cost" of all the servers that comprise companies' intranets and the Internet in general: the intense power requirements needed to run and cool data centres now account for almost a quarter of global CO_2 emissions from information and communications technology. Data centre emissions are increasing faster than other carbon emissions. The main reasons for the scale of current emissions are a lack of floor space, a failure to house high density servers, increased power consumption, and heat generation. In addition, the Net links hundreds of millions of PCs that, when operating at 40 hours per week, will each release about 352kg of CO_2 per year according to a UK study.

"In an energy-constrained world, we cannot continue to grow the footprint of the Internet… we need to rein in the energy consumption," said Subodh Bapat, vice-president at Sun Microsystems, one of the world's largest manufacturers of web servers. *Guardian 5/2009*

'Printing is the only media with a one-time carbon footprint — all other media require energy every time they are looked at'.



***"Energy Efficient Data Centres – Best-Practice Examples from Europe, the USA and Asia"** Federal ministry for the Environment, nature Conservation and nuclear Safety, Germany, 2010. This report found that internet servers consumed about 1% of total worldwide electricity in 2005. In 2004, CO_2 emissions from ICT-related power consumption in Germany alone was over 28 million tonnes CO_2e, considerably higher than the emissions from aviation. By 2007 consumption in the ICT sector rose to about 10,5% of Germany's electricity consumption.*

'Paper is the most successful communications innovation of the last 2000 years, the one that has lasted the longest and had the profoundest effect on civilisation. Without the technology that is paper, there would be no civilisation. Yet most people don't even think of paper as a technology.'

William Powers, Hamlet's Blackberry

Ink-on-paper as a sustainable media technology

The pulp and paper industry is one of the world's biggest users of renewable, low-carbon energy. Around 50% of the primary energy used to make paper in Europe and the US comes from carbon neutral renewable resources and is produced on site at mills. In comparison, most IT data systems rely on conventional distributed power generation using fossil fuels.

Sustainability:
Paper is one of the most sustainable industries in Europe today, with a strategy to use natural resources in an efficient way, reducing negative environmental and social impacts and meeting society's need for sustainable consumption. According to CEPI, the industry's successes are based on: an active commitment to sustainable forest management, helping to nurture Europe's increasing forest area; a drive to increase recycling that has made paper the most recycled product in Europe; and a commitment to renewable energy that has made the industry the biggest user and producer of renewable energy in Europe.

Environment:
For more than a decade the European paper industry has invested an average €560 million a year in environmental improvements. The result has been the 'decoupling' of environmental impacts from production growth with more paper is being produced today than in 1990 but with a decreased impact on the environment. A sustainable approach to resources, promoting sustainable forest management, implementing environmental management systems and eco design ensure that products are safe, fit for use and recyclable.

Forest:
Wood and recovered paper are amongst the most sustainable raw materials in the world because they are renewable and recyclable. These unique qualities are central to the paper industry but their benefits are not always recognised. For example, contrary to public opinion, Europe's forests are increasing by an area equivalent to 1.5 million football pitches every year, driven by responsible forest management. Forests also provide vital income and employment in rural areas and down the forest-based chain. However, policies impacting forests and the paper industry do not always reflect the 'big picture' on sustainability.

Energy:
This has been a key issue for the European paper industry for a long time. Because energy can account for up to 30% of its costs, the industry has looked to sustainable and renewable sources. Today, it is the one of the least fossil fuel intensive industries in Europe and the continent's biggest industrial user and producer of renewable energy – half of the energy used in paper mills is from renewable sources. The industry has invested heavily in combined heat and power generation (CHP) that now produces 96% of its on-site electricity, and sustained efforts have reduced CO_2 emissions by 42% per tonne since 1990 (CEPPI).

The increasing competition between wood for bio-energy and for the paper industry presents a new challenge. A recent European Environment Agency Report *"How much bio-energy can Europe produce without harming the Environment?"* only forecasts an annual additional potential of 200 million m^3 of biomass in Europe's forests. CEPI questions how more ambitious targets on wood for bio-energy can be met without risking the overall sustainability of Europe's forest and agricultural resources as well as the competitiveness of the sector. This is particularly relevant in the light of the new EU targets for energy from renewable sources to be fulfilled by 2020.

CEPI has recently published an independent study showing that using wood as a resource for paper products first and only using it as a source of energy at the end of the product lifecycle adds four times more added value to the economy and retains six times more jobs than simply burning wood for energy. This becomes particularly relevant in light of the new EU targets for energy from renewable sources to be fulfilled by 2020.

Recycling – a key to improved performance

Recycling can have a significant impact in the reduction of GHGs and energy use. The paper and steel industries are the recycling leaders in Europe with over 50% of their raw materials for production coming from recovered products, followed by glass 43%, and other non-ferrous metals 40%.

Recycling should be used where it results in lower environmental impacts than alternative recovery options and where other requirements, such as safety, and product performance, are met. Some types of recovered material are also a valuable source of energy (incineration with energy recovery) at the end of their useful life as a material.

Landfill of untreated organic waste is being reduced in all developed countries because biodegradation of stored organic material has a risk of generating methane emissions – a gas 25 times more potent than CO_2. Some landfill sites are installing methane gas capture systems to generate renewable energy. Diverting more paper from landfill to recycling is a key goal for to meet the EC Landfill Directive goal to recover 65% of all biodegradable materials by 2016.

'On average 55% of the fibre used for paper production in Europe is from recovered paper'.

Paper:
A world record 72% of paper was recycled in Europe (58 million tonnes) for 2009 — the recycling rate is the ratio between the recycling and consumption of paper(ERPC).

Pulping of recovered paper uses about 80% less electrical energy in recycling than virgin mechanical pulp (0.4 MWEh/tonne v. 2-2.5 MWEh/tonne) but requires more steam generated from fossil fuel. Recycled fibre has an important role to play in energy efficiency but it should be used in appropriate grades whilst ensuring that the fibre used meets the requirements of the end-paper quality required. Paper and board can be recycled up to 5-6 times before it loses its properties, at the end of life it can be used for energy production. The production of recycled paper requires continuous entry of virgin pulp into the fibre chain.

The European Declaration on Paper Recycling signatories includes the European Associations of the paper and printing industry, publishers of newspapers and magazines, as well as manufacturers of printing inks and adhesives. The goal is to improve the handling of recovered paper throughout the entire value chain. The 14 industry sectors in the European Recovered Paper Council (ERPC) are driving eco-design to make recovered paper a more heterogeneous stream that is more reliable and easier to recycle. The relevant parts of the paper value chain are introducing eco-design principles to inks and adhesives known to cause problems.

Report describes repulpability testing of hot and cold foil printed samples.

The use of more recovered pulp in grades other than newsprint requires improved de-inkability of printed paper products. The ERPC's 2008 *"Guide to an Optimum Ability of Printed Graphic Paper"* evaluates most printing processes as having good de-inkability but with reservations on some inks (UV, newspaper flexo, digital inkjet and liquid toners) that may have negative impacts on the quality of recycled pulp if their volume in the recycled waste stream increases. Inkjet formulations available in 2010 apparently overcome this reservation.

Foil:
The 2009 PIRA report "Repulpability of Foil Decorated Paper" concludes that both hot and cold foil decorated printing it tested would cause no problems in recycling.

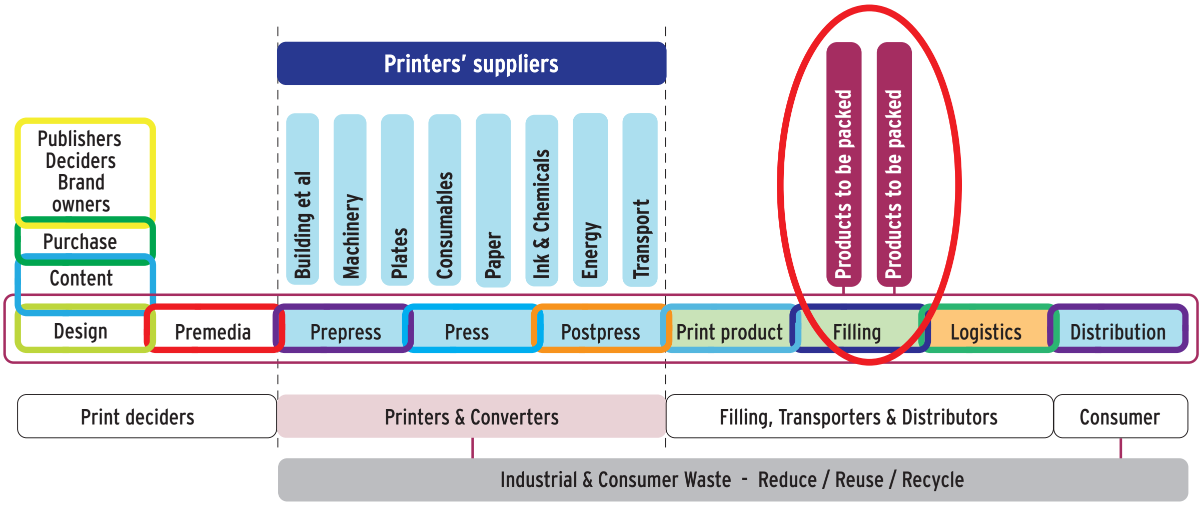
Other materials:
Aluminium offset printing plates have a high recovery rate of around 99% and when recycled into other products consume only 10% of the energy for smelting virgin aluminium. However, currently this CO_2 'credit' is not expressed as part of the carbon footprint of offset plates. Plastics, wood and other materials also justify organised recycling.

This report provides an excellent overview of recycling printed products in Europe.

Calculation & Allocation

There is currently a discussion on the question of how the initial emissions should be allocated. For example, recycled paper exists only because virgin paper was manufactured. Therefore, there is a view that a part of the energy initially used to make virgin material should be allocated to recycled materials to provide a better balance of emission source.

Carbon impact on packaging



Packaging's value chain is the same as that of a print media product up to the point at which it is converted. After this point the packaging material becomes one of a number of elements that constitute a packaged product.
Source PrintCity

'Lightweighting and optimising material use will play an increasingly important role in the eco efficiency of a package including its Carbon Footprint'.

Packaging serves a unique function because it provides a fit-for-purpose solution to ensure that the articles or products transported within the package arrive at their final destination safely and undamaged.

The nature of the product to be packed determines the functional type(s) of package that can be used. For many food and beverage products, for example, plastic, glass or metal are often essential to provide functional protection and preservation. However, for many other consumer and industrial products the choice of substrate is less clear-cut and in these applications the Carbon Footprint of a package will play an increasingly important role in deciding which material best meets both functional and environmental needs. The Carbon Footprint will not just be for the manufacture of the package but also should include its use, disposal and recycling.

While the basic methods of carbon measurement and management apply equally to both packaging and printed products, it is far more complex to apply in the packaging context because of the variable nature and needs of the products to be packed. A printed package represents only a small part of a packaged good's total Carbon Footprint in proportion to its contents.

This challenge is described in "Packaging in the Sustainability Agenda: A Guide for Corporate Decision Makers" EUROPEN (European Organisation for Packaging and the Environment) and ECR (Efficient Consumer Response) 2009, as:

"Consumer perceptions, fuelled by media calls for more 'sustainable' packaging, are making life difficult for companies. Worse, they can lead to misguided legislative pressures. The key problem is that packaging is usually viewed by media and consumers as a stand-alone product. This ignores its fundamental role, which is to protect, distribute and display wares. Without packaging, food rots, fragile products get broken, and distribution becomes hazardous. The entire supply chain becomes hugely inefficient."

Packaging is essential, 'though seldom seen to be so. The entire supply chain from the initial sourcing of raw materials through to consumer product disposal is dependent on packaging.

While packaging has a number of functions, its fundamental role is to deliver the product to the consumer in perfect condition. Good packaging uses only as much of the right kind of material as necessary to perform this task. As packaging is reduced, the range of scenarios under which product losses occur rises until, eventually, a point is reached where the increase in product loss exceeds the savings from the use of less packaging material. Any reduction in packaging beyond that point is a false economy since it increases the total amount of waste in the system.

Source reduction, reusability and/or recoverability (including recycling) are legal requirements for packaging within the European Union. Industry has a long commitment to delivering products to consumers at minimal environmental and economic cost. A multitude of strategies, including source reduction, lightweighting, material selection and improved compatibility of packaging with existing recycling and recovery schemes are employed to this end. (Examples of such improvements and how they were achieved can be found in the INCPEN report *"Packaging Reduction: Doing More with Less"*.)

A systematic approach that addresses the entire packed product system is essential to ensure that individual improvements contribute to overall product sustainability. EUROPEN summarises some key issues as:

Greenhouse gases of packaging: Carbon Footprinting is a way to measure one of the environmental impact categories that should be considered during a lifecycle assessment. Given the huge potential impact of climate change, it should be seen as a very significant parameter. However, it is important to ensure that Carbon Footprint reductions are not achieved at the expense of other environmental impacts for a product and its packaging in order to avoid simply shifting environmental burdens from one impact category to another.

Packaging, energy consumption and resources: Packaging typically amounts to no more than 8-10% of the resources embedded in packaged foods and beverage used in the household. Each household's annual purchases of products weighs nearly 3 tonnes and requires 110 Gigajoules of energy to produce. To avoid wastage of these products and the energy used to produce them, they need to be protected so they safely survive the stresses and strains of being transported from farm and factory through to the shops and then to consumers. Less than 200kg of packaging does this job and the energy used to make the packaging is just seven Gigajoules – or one fifteenth of the energy used to produce the goods. Of the total energy used in the food chain, 50% is used in food production, 10% on transport to the shops and retailing, 10% to make the packaging and the remaining 30% is used by shoppers to drive to the shops and store and cook food.

Recycling: Paper and board packaging remains the EU champion of recycling. The industry currently recycles over 84% of its paper and board packaging – a level that easily exceeds the target set in Directive 94/62/EC on packaging and packaging waste set at 60% by 2008. (EMIP)

The Sustainable Packaging Coalition has identified sustainability as packaging that is beneficial, safe and healthy for individuals and communities throughout its lifecycle, while meeting criteria for performance and cost; that is sourced, manufactured, transported and recycled using a maximum of renewable or recycled source materials, combined heat and power generation and renewable energy; and is manufactured using clean production technologies and best practices from materials that are healthy in all probable end of life scenarios – effectively recovered and utilised in biological and/or industrial cradle-to-cradle cycles.

Packaging brand owners are generally also intensive users of other media such as magazines, newspapers and advertising leaflets; therefore, there should be maximum compatibility between all carbon footprint approaches for both simplicity and transparency.

'Carbon Footprinting is a way to measure one of the environmental impact categories that should be considered during a lifecycle assessment'.

This section is based on "Packaging in the Sustainability Agenda: A Guide for Corporate Decision Makers" EUROPEN and ECR 2009, www.incpen.org.

Packaging Reduction Examples

	1950s	1960s	1970s	1990s	2000	2008	% change
Washing-up liquid bottle (1 litre)	–	–	120 g	67 g	50 g	43 g	64%
Soup can (400 g)	90 g	–	69 g	57 g	55 g	49 g	46%
Yoghurt pot (165 g)	–	12 g	7 g	5 g	–	4 g	67%
Plastics fizzy drinks bottle (2 litre)	–	–	58 g	–	43 g	40 g	31%
Metal drinks can (330 ml)	–	60 g	–	21 g	15 g	14 g	77%
Glass beer bottle (275 g)	–	–	450 g	–	325 g	176 g	61%
Glass milk bottle (1 pint)	538 g	–	397 g	230 g	–	186 g	65%

The trend to reduce the average weight of packaging was driven by cost, transport and waste disposal. In recent years the carbon footprint has become an added driver.

Source INCPEN

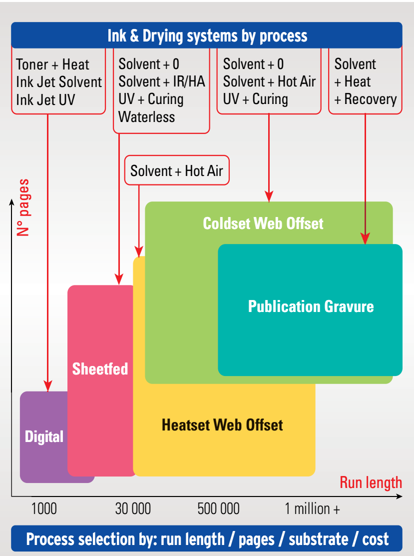
Carbon Footprint evaluation

'All calculation systems should provide a reference to the source of CO_2 equivalent data used'.

The term represents the idea that a 'footprint' traces the result of an activity. The objective of Carbon Footprinting is to measure the GHG emissions of a business, production site, product, or service. The primary reason to do this is to drive steps to reduce GHG emissions and fossil energy use. A secondary reason is to act as a base for carbon offsetting and communication.

In Europe, Carbon Footprint calculators have been predominately developed by industry associations. These tend to focus on identifying GHGs to reduce them at production sites and in products, while compensation is secondary. Generally, they conform to standards and are relatively open. Various services are available that can include training, measurement, consulting, offsetting, certification, and benchmarking. Some printers use non-industry commercial carbon calculators that tend to have a primary focus on emission compensation and may not conform to standards or offer much transparency. Some printing companies have developed their own proprietary systems.

The different calculation models used in Europe have different scopes and levels of detail. Systems to calculate CO_2 emissions need to adopt an international approach and be used easily by both large and small companies. All calculation systems should provide a reference to the source of CO_2 equivalent data used in the respective models.



Source PrintCity 2009

The printing industry is characterised by multiple processes and substrates, some processes can have multiple ink-drying systems. It is not unusual that a single job will use multiple processes and substrates. Therefore, a single standardised CO_2e calculation methodology should be used to achieve a coherent result. CO_2e is only one of several parameters to select a print process and the dominant criteria will continue to be run length, number of pages, substrate, and cost.

Some of the carbon calculation systems in use in Europe include:

ClimateCalc Consortium: A common international software calculation tool was launched in 2011, along with supporting services of training and certification. The consortium was formed by printing federations from Denmark (GA), Netherlands (KVGO), Belgium (FEBELGRA) and France (UNIC) who substantially elaborated the INTERGRAF recommendations on the calculation of Carbon Footprint of graphic production. The software provides a coherent and transparent tool to calculate the climate impact from both a company and of specific print products. It will also facilitate a data platform and encourage collaboration across the value chain with participation from advisory groups from print suppliers and users. The calculator is based on the system developed by the Graphic Association of Denmark. The consortium is open to membership applications from other industry association. www.climatecalc.eu

Bilan Carbone® ADEME: UNIC, the French printers' association, has been using the Bilan Carbone® method for printing applications since 2008. Users include printers, magazines and book publishers, banks, and insurance companies. A key success factor is an open exchange where suppliers can propose solutions to find collaborative solutions to reduce emissions. The principal tool is an open-source software using simple Excel files with exact emission factors used that allows changes to emission factors and permits integration of specific raw materials and associated emission factors. It is a carbon management tool to calculate both GHG direct and related emissions. It is a continuous improvement system based on: Team management climate change awareness; definition of the study's scope data collection; data analysis; identify actions for reduction; and launch. The results are updated yearly to verify that identified goals are reached.

BPIF: The UK has been proactive in Carbon Footprinting, largely due to a high profile public/private cooperation fostered by the Carbon Trust. The BPIF calculator ranks results to reveal the most carbon-intensive parts of production where reduction can have the most impact. Printers can choose to have the remaining carbon offset by companies such as the Carbon Neutral Company. The calculation methodology is inline with GHG Protocol and PAS 2050. The primary data is sourced from invoices and energy metering. Site carbon footprint GHG emission measurements include energy consumption, material consumption, business travel, waste and its disposal, and transportation. The product carbon footprint GHG emission also includes its disposal.

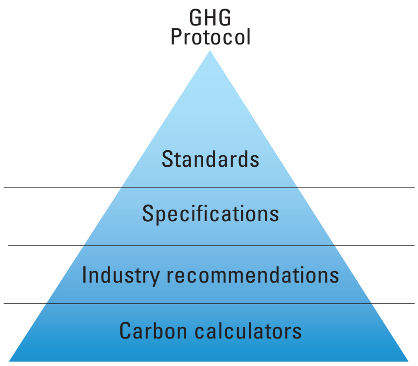
BVDM — German printers' association: The Climate Initiative aims to sensitise printing and media businesses to the CO_2 relevance of the print value chain and to give them the opportunity to demonstrate active commitment to climate protection. The initiative is a three stage system: 1, CO_2 avoidance from analysis at the printing plant to identify opportunities to reduce energy consumption; 2, calculation of CO_2 from a print job using a web-based calculator; 3, compensation of emissions through Gold Standard certificates — claimed to be the world's most highly respected standard for sustainable emission reduction and is backed by the WWF. The web based climate calculator is used by around 170 printers (as of 06/2010). Process specific versions are available for sheetfed, heatset, coldset, gravure, packaging, and digital printing and the calculated results comply with DIN/ISO 14040 and 14044.

Forestry Industry Carbon Assessment Tool (FICAT) is a comprehensive GHG calculation tool developed for the forestry industry under the auspices of the US Environmental National Council for Air and Stream Improvement (NCASI). The free software (www.ficatmodel.org) uses the CEPI 'Ten Toes' principal and calculates the GHGs in each of the 'Toes'.

Periodical Publishing Association (PPA) developed a carbon calculator specific to the magazine supply chain in the UK in collaboration with paper producers, printers, distributors and wholesalers. The industry-wide study measured supply chain stages from paper production through printing, finishing, subscription, distribution, to disposal and recycling, as well as packaging waste. All relevant CO_2e emission sources, including energy, were included, but not activities related to the production of magazine content. Total emissions from each stage of the process were calculated and turned into a CO_2 measurement using the IPCC guidelines and the results audited by an independent third party, ECCM. The result is a model that maps the industry processes that give rise to emissions and the points at which these processes overlap. The calculator allows publishers to calculate their environmental impact and make informed decisions on how to reduce their footprint and engage with supply chain partners to achieve their future environmental aims.

'13 principal parameters usually cover around 95% of all GHG emissions in the lifecycle of printed material'.

Printing and Paper Technology Association (Fachverband Druck und Papiertechnik) within the German Engineering Federation (VDMA) is cooperating with the German printing press manufacturers Heidelberg, KBA and manroland to elaborate a guideline for standardised energy measurement on sheetfed offset presses. This will allow more objective assessment of energy consumption and efficiency, and for more accurate calculation of operating costs and Carbon Footprinting. "Guideline for determining the specific power consumption of sheetfed offset presses. Part 1: Presses with or without sheet reversing device, conventional" was published in November 2010. A similar standard for web offset presses is planned. Draft documents in English and German from dup@vdma.org.



The descending hierarchy of importance of different 'rules and tools' for Carbon and Energy measurement. In reality Carbon Calculators have different levels of conformity and complexity.
Source PrintCity

Intergraf's Top 13 CO_2e parameters

Parameter — source of emissions	Relevant to	GHGP Scope
1- Production of purchased substrate — paper or plastic	Product	3
2- On-site combustion of fuels — direct emission	Site	1
3- Production of inks and coatings	Product	3
4- Production of purchased energy	Site	3
5- Production of aluminium plates or gravure cylinders	Site	3
6- Transport of finished product to customer's first delivery point	Product	3
7- Company owned or leased vehicles	Site	1
8- Transport of raw materials to the printer — paper	Product	3
9- Production of purchased packaging materials	Product	3
10- Production of fuels (upsteam)	Site	3
11- Purchased energy (upstream and transmission losses)	Site	3
12- Production of IPA and cleaning agents	Site	3
13- Employees commuting	Site	3

Intergraf recommends that 13 principal parameters be included in any calculation of emissions of a printing site or product because these usually cover around 95% of all GHG emissions in the lifecycle of printed material – this scope excludes emissions related to capital assets, customer distribution and end-of-life of printed material. The recommendations were developed with several member federations, some of whom have developed their own calculators, and were based on analysis of publication gravure, sheetfed and heatset offset.

These recommendations exclude some parameters that, in normal operating conditions, represent a maximum of 5% of the defined scope (e.g. plate developing agents, fountain solution, gum, blankets; transport of raw materials other than the substrate; transport and treatment of production waste and waste water). Some of these parameters may influence the calculation with more than 5% under certain operating conditions. Small runs may influence the amount of waste to the extent that 5% could be exceeded. The recommendation assumes that used plates are recycled. The parameter, direct emissions from combustion, covers exclusively fossil fuel.

Excluded from the scope of Intergraf's current guidelines are: capital assets such as buildings and machines are not currently included because there is no clear consensus on their impact and calculation of emissions; and emissions from end-of-life treatment of paper products (the inclusion of recycling and incineration could result in a smaller CF and Intergraf intends to include this aspect in the future when more reliable calculation models are available).

"Site" parameters can be calculated based on average data for the company while "product" parameters must be calculated according to the exact specifications of the product under consideration.

The UK Carbon Trust publishes excellent guides on carbon Foot printing and energy conservation.

Carbon Management and Energy Efficiency Road Map.
Source Environ/Sun Chemical

Identify & prioritise actions

'Standard operating procedures and regular preventive maintenance is essential to ensure operational energy efficiency.'

The results of a carbon footprint and energy audit will allow the prioritisation of actions; these should take into account:

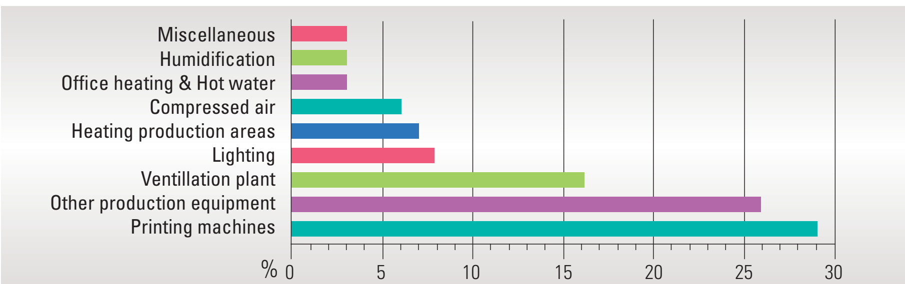
- What parameters are under control of the printer?
- What parameters are under control of the customer?
- What parameters are under control of suppliers?
- What actions have low cost and short term to implement – expected return on investment?
- What actions have higher cost and mid to long term to implement – expected return on investment?

Choices can be made to help reduce the environmental impact of the printing, publishing and packaging industry. The most important factor is timely and frequent consultations with printers and paper suppliers to evaluate the process, materials and design criteria. It is important to take into account regional variations that may change a preference.

The PrintCity Energy Efficiency report summarises that the optimal way to conserve environmental resources and reduce operating costs is to take an holistic approach to the design and running of production plants:

1. **Building & services:** Building energy consumption is around half to one third of that used for production. Readily available savings opportunities include: eliminating excessive consumption from overheating, lighting areas not in use, draughts, heat loss and air leaks; computerised control of heating, ventilation, air-conditioning and other support systems; new lighting technologies that can save up to 50% of energy; and improving the energy efficiency of buildings and their use.
2. **Internal transport:** Minimising workflow distances and using best practice operating procedures can improve internal transport efficiency. Effective maintenance of roll and lift truck units will significantly lower their energy consumption.
3. **Production equipment:** Selecting technologies with the best lifecycle costs, including all ancillary systems; taking into account the economic viability of recovering waste heat for cooling and heating, or to generate electricity; optimised running of the production equipment. When assessing new equipment it is important to assess lifetime energy consumption.
4. **Standard operating procedures and regular preventive maintenance:** Are essential to ensure operational energy efficiency (correct lubrication and settings, air filters are not blocked, etc).

Improvement measures can be direct and indirect. Direct measures include, for example, energy savings achieved by technical or organisational changes and substitution of raw materials (or of a supplier or a process). Indirect measures may involve such actions as positively influencing employees' behaviour, e.g. switching off light/equipment whenever not needed, implementing improved processes with suppliers or customers, e.g. optimised logistics.



Example breakdown of % energy cost in a German printing plant.
Source ENVIRON/Sun Chemical

You can't manage what you don't measure

"Good energy monitoring allows better understanding of where and how energy is being used, to identify areas where energy consumption can be recycled to save money and reduce GHG emissions, and confirm whether energy-saving measures are working. Using a meter to help monitor your energy typically identifies energy savings of more than 5%."

Financial appraisal for energy efficiency projects

It is important to assess the financial returns from investment in carbon and energy efficiency measures. There are a number of techniques available:

Simple Payback: This is a straightforward method which simply divides the capital cost of the investment by the expected annual financial savings to give a measure of how quickly the investment will be repaid, expressed in years. It can be misleading, however, as it does not take account of the benefits of the project into the future.

Net Present Value (NPV): NPV measures the difference between the present value (PV) of the future cash flows from an investment in an energy efficiency project and the amount of investment. Present value of the expected cash flows is computed by discounting them at the required rate of return (also called minimum rate of return). A zero NPV means the project repays original investment plus the required rate of return. A positive NPV means a better return, and a negative NPV means a worse return than the return from zero NPV. It is one of the two discounted cash flow (DCF) techniques (the other is internal rate of return) used in comparative appraisal of investment proposals where the flow of income varies over time.

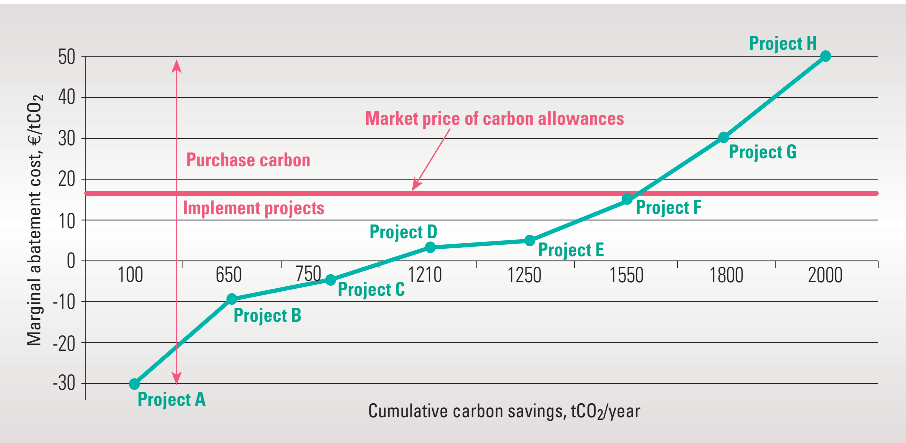
Internal Rate of Return (IRR): IRR expresses the rate of return that would make the present value of future cash flows plus the final market value of an investment or business opportunity equal the current market price of the investment or opportunity. The internal rate of return is an important calculation used frequently to determine if a given investment is worthwhile. An investment is generally considered worthwhile if the internal rate of return is greater than the return of an average similar investment opportunity, or if it is greater than the cost of capital of the opportunity.

Marginal Abatement Cost (MAC): MAC expresses the value of an opportunity in terms of the cash value of the opportunity divided by the expected carbon saving. This is useful when participating in an emissions trading scheme where this technique can be used to prioritise a series of measures and make a judgement on whether to invest in an opportunity or to purchase carbon credits in order to meet carbon targets. This is done by ranking the projects in order of increasing MAC and plotting them on a Marginal Abatement Cost Curve (MACC).

'Good energy monitoring allows better understanding of where and how energy is being used, to save money and reduce GHG emissions'.

"How to monitor your energy use" Carbon Trust, 2006. Practical actions include good data collection:

- If you read your meter manually make sure that you take readings at regular intervals. The more meter readings you take, the better the picture you can build of your site's consumption. Consider installing individual meters on higher energy using machines. To get a rapid overview of consumption, some energy suppliers provide access to consumption readings at 30-minute periods. Record data into a spreadsheet to plot energy against time. Understand your energy use in relation to the pattern of production and occupation of the site over time. Identify potential waste areas to make changes. Finally, monitor data to see if the changes have worked.
- Consider installing sub-meters on equipment that uses lots of energy to detail its consumption patterns. Automatic meter reading systems provide accurate and timely data with the minimum of effort. These systems allow readings in real time to quickly identify savings opportunities and often cover their cost in less than a year. Meters cost around €200 but there will be additional costs to network meters, record and analyse information.



Example of Marginal Abatement Cost Curve.
Source ENVIRON/Sun Chemical

'Process optimisation should begin with workflow and process control, and the use of quality standards to minimise waste'.

Printers and publishers can influence this parameter in a number of ways:

- **Use lighter weight paper/board to yield more copies per tonne.** There is an almost linear relationship between paper weight, energy consumption and GHG per printed and delivered copy. Lighter weight paper/board has been an underlying trend for over 10 years in newspapers, magazines and packaging.
- **Reducing format size.** Some publications and advertising catalogues are using smaller formats to reduce costs; this also reduces GHGs from less paper, ink, chemicals and transport.
- **Improve distribution efficiency.** Minimise publishing return copies – around 30-40% of many publications are unsold and recycled. Use of Geodata Information Systems and driver training can minimise transport distance and fuel consumption.
- **Optimise print run length.** Are mailing lists regularly updated? Remove duplications and use more target-specific lists to minimise print and mailing quantities and reduce cost and environmental impact.
- **Minimise production waste.** Are the production processes really optimised? Is there a continuous improvement approach to reducing printing and post-press waste?
- **Minimise storage and handling.** This can often represent 1-3% of paper waste.
- **Promote actions for consumer recycling.** Improve recycling rate.

Top 13 CO_2e parameters: Reduce – Reuse – Recycle

Around 13 parameters are generally responsible for over 95% of a printer's CO_2e. Although these may vary a little – type of printing process, substrate, and job structure – they provide a good base to illustrate the prioritisation of actions to reduce energy and GHG emissions.

Process optimisation should begin with workflow and process control, the use of quality standards and profiles for each paper type to minimise paper waste, overinking, and any drying energy required.

1. SUBSTRATES: *Emissions from production of purchased substrate (e.g. paper and plastic) is completely the responsibility of the manufacturers.*

Paper is the single largest source of CO_2e emissions because it has the largest mass. It is also the largest cost factor for printed products.

2. ON-SITE COMBUSTION OF FUELS: *Direct emissions from the on-site combustion of fuels (natural gas, fuel oils, LPG gas, Coal, Heatset inks). Production of the combusted fuels are described separately (Point 10).*

3. PRODUCTION OF INKS & VARNISHES: *Emissions from their production is completely the responsibility of the manufacturers.*

- **Design to minimise ink coverage.** Reduces usage of curing resources and drying energy. The amount of ink required to achieve target print densities has an impact on energy used in printing and ink demand is primarily related to the type of paper. The effective use of UCR (Under Colour Removal) and UCA (Under Colour Addition) can reduce ink consumption.
- **Use finer screens.** Comparative heatset ink consumption tests by GATF in 2004 showed that the conventional AM69 l/cm (175 lpi) and 25 micron Alternative Screening Technologies (AST) both used 15% less ink than conventional AM52 l/cm (133 lpi) screens. The experience of some large AST users indicates savings of 10-15%. The use of densitometers or closed loop colour control reduces a natural tendency to overinking.

4. PRODUCTION OF PURCHASED ENERGY: *Emissions from production of purchased energy consumed on-site (indirect emission) including electricity, steam, district heating, compressed air, cooled water. Production of fuels used for energy production and transmission losses are described separately (Point 11).*

- Analyse energy use and efficiency.

5. PRODUCTION OF ALUMINIUM PLATES / GRAVURE CYLINDERS: *Emissions from production of purchased aluminium plates is completely the responsibility of the manufacturers.*

- Reduction in energy and carbon of aluminium plates (and other image carriers) is completely the responsibility of the manufacturers.
- Minimise plate processing from using CTP (eliminate film) and low process-less plates to reduce energy, chemicals and residual waste.
- Correct maintenance of imaging and processing system and use of plate test wedges to minimise number of plates re-manufactured.

6. TRANSPORT OF FINISHED PRODUCT: *Emissions from transport of the finished product to the first point of delivery of the primary customer. Further transport (to point-of-sale or end-users) is to be accounted by customers, such as publishers. Production of the combusted fuels described separately.*

- Use Geodata Information Systems to minimise distances and driver training to minimise fuel consumption.

7. COMPANY VEHICLES: *Emissions from combustion of fuels in company owned or leased vehicles (direct emission). Production of the combusted fuels described separately.*

- Purchase or lease vehicles on basis of low CO_2 and fuel consumption.
- Rationalise route planning to minimise distances driven.

- Eliminate journeys by making better use of internet, teleconferencing, etc.
- Can virtual proofing eliminate physical exchange with customers (as well as materials, processing and supply logistics of substrate based proofs)?

8. TRANSPORT OF RAW MATERIALS: *Emissions from transport of substrates from production site of the material to the printer should be included. Transportation of other raw materials, e.g. chemicals, printing plates and packaging materials, can normally be left out due to low relevance (except for sites with very high volumes such as web printers). Production of the combusted fuels described separately.*

- Review with suppliers the most energy and carbon efficient sources of supply and the transportation options available.

9. PRODUCTION OF PACKAGING MATERIALS: *Emissions from production of purchased packaging materials, e.g. cartons and PE-plastic, is completely the responsibility of the manufacturers.*

- Analyse how to optimise materials used.

10. PRODUCTION OF FUELS (upstream): *Emissions from production and transportation of fuels for on-site combustion and transportation.*

- Analyse energy use and efficiency.

11. PURCHASED ENERGY (upstream & transmission losses): *Emissions from production and transportation of fuels for production of purchased energy. Transmission losses of purchased energy.*

- Analyse energy use and efficiency.

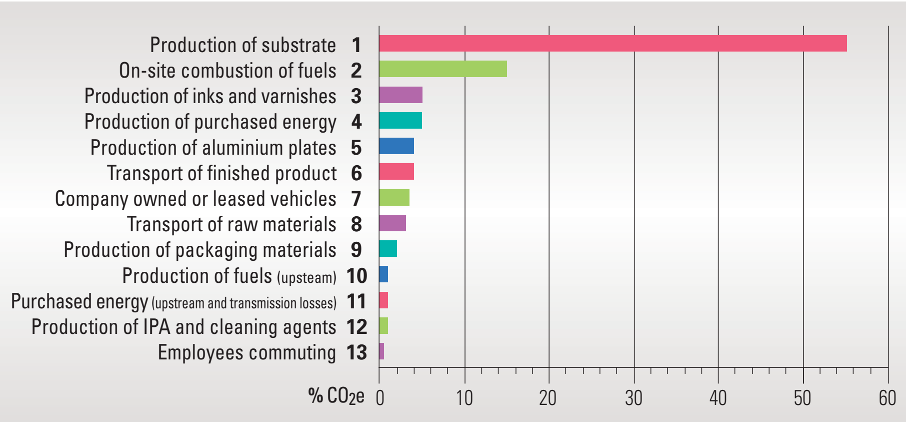
12. PRODUCTION OF IPA & CLEANING AGENTS: *Emissions from production of purchased IPA and cleaning agents is completely the responsibility of manufacturers. Production of other raw materials, e.g. plate developing agents, dampening solution, gum and blankets, can normally be left out due to low relevance.*

- Replace or reduce IPA used.
- Initiate best practices for cleaning and maintenance.
- Review type and quantities of adhesives used.

13. EMPLOYEES COMMUTING: *Emissions from commuting by workers from their home to the workplace should be considered in calculations. The travelling of workers and the emissions deriving from it is highly dependent on the geographic location of the company and its employees. For some companies it can, therefore, be an important source of emissions, which is why it should be considered in calculation models. The travelling of visitors to the company is, however, not considered. Production of the combusted fuels is described separately.*

- Car pooling.
- Interest-free bike loans with secure storage and changing areas.

'Finer screening with UCR and UCA in prepress will reduce ink consumption and also related curing and drying energy.'



These GHG values provide an illustrative example of proportions of CO_2e emission but should not be interpreted as representative values for the European printing industry in general.

Source UNIC

Carbon & energy across the supply chain

Consumables Paper & fibre board — 10 environmental toes

The paper industry is making information more transparent to allow printers and publishers to make a balanced environmental paper selection that can include the calculation of a print product's Carbon Footprint.

Highlighted are the paper profile toes relevant for a cradle-to-gate carbon footprint calculation. Not included are the emissions associated with the capital manufacturing equipment. Source UPM/CEPI

1- Carbon sequestration in the forest
2- Carbon stored in the product
3- GHG emissions from pulp and paper production
4- GHG emissions associated with producing virgin or recovered fibre
5- GHG emissions associated with producing other raw materials
6- GHG emissions associated with purchased electricity and steam
7- Transport-related GHG emission
8- GHG emissions attributable to product use
9- GHG emissions attributable to end-of-life-management of products
10- Avoided emissions

CEPI's 2007 framework on carbon footprint is not a standard and is open to interpretation. There are specific modules for carton board, corrugated and fine paper. Some comments on the 10 toes:

1. Carbon sequestration in forests: Sustainable forest management secures stocks of carbon in forests to stay neutral.

2. Carbon in forest products: Cellulose fibre is a natural carbohydrate and stores carbon away from the atmosphere as long as it remains a product; this is extended by recycling, but carbon will be released on disposal.

3. GHG emissions from pulp and paper production: The direct GHG emissions of a paper mill, the power plant, air foils, fork-lift trucks.

4. GHG emissions associated with producing fibre: Virgin fibre includes forest management and harvesting. Recovered fibre includes collection, sorting and processing before it enters the recycling process.

5. GHG emissions associated with producing other raw materials/fuels: Fuels, chemicals and additives used in the manufacture of forest products and the direct emissions and other emissions associated with purchased electricity to manufacture these raw materials.

6. GHG emissions associated with purchased electricity, steam, heat, hot and cold water: Used at production facilities, including electricity for pollution control. There are CO_2 emissions associated with the electricity generation in power stations depending on their efficiency and fuel used.

7. GHG emissions transport-related: Transport of raw materials and products along the value chain, e.g. wood to the pulp mill, pulp to the paper mill, paper to the printer, transport of all other raw materials and waste to place of disposal.

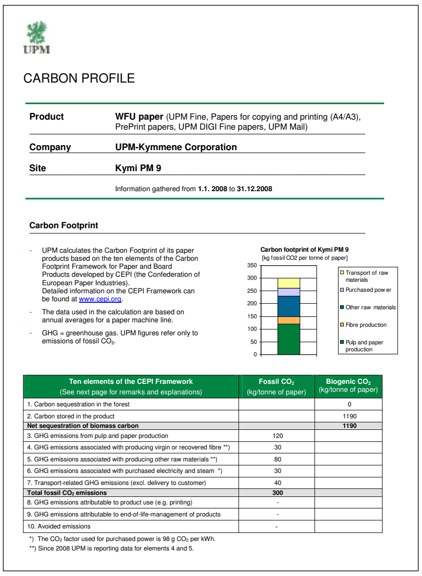
8. Emissions associated with product use: These are currently unusual for forest products and a key asset of paper compared to electronic media for some applications.

9. Emissions associated with product end-of-life: Primarily of CH4 (methane) from the anaerobic decomposition of forest products in landfills. Variable,depending on a country's waste infrastructure. It ranges from landfill where methane can be formed through biological degradation (e.g. USA) to countries where no landfill of organic waste containing paper is permitted (e.g. Austria, Germany, the Netherlands).

10. Avoided emissions and offsets: Emissions that do not occur because of a product attribute or an activity of the company making the product.

Paper Profile presenting data on essential environmental parameters in a uniformed way for specific products to enable paper buyers to make informed product choices. It is a voluntary environmental product declaration scheme developed and provided by leading paper producers including Arctic Paper, Burgo Group, Clairefontaine, Grycksbo Paper, Holmen Paper, International Paper, LECTA, Lenzing Papier, Mondi AG, M-real, Myllykoski Corp., Norske Skog, Papierfabrik Scheufelen, Portucel Soporcel, Sappi, SCA Forest Products, Stora Enso, UPM and VIDA Paper.

UPM's Carbon Profile is based on the CEPI Framework and distributed together with the Paper Profile.


UPM

CARBON PROFILE

Product	**WFU paper** (UPM Fine, Papers for copying and printing (A4/A3), PrePrint papers, UPM DIGI Fine papers, UPM Mail)
Company	**UPM-Kymmene Corporation**
Site	**Kymi PM 9**
	Information gathered from **1.1. 2008** to **31.12.2008**

Carbon Footprint

- UPM calculates the Carbon Footprint of its paper products based on the ten elements of the Carbon Footprint Framework for Paper and Board Products developed by CEPI (the Confederation of European Paper Industries). Detailed information on the CEPI Framework can be found at www.cepi.org.
- The data used in the calculation are based on annual averages for a paper machine line.
- GHG = greenhouse gas. UPM figures refer only to emissions of fossil CO_2.

Ten elements of the CEPI Framework (See next page for remarks and explanations)	Fossil CO_2 (kg/tonne of paper)	Biogenic CO_2 (kg/tonne of paper)
1. Carbon sequestration in the forest		0
2. Carbon stored in the product		1190
Net sequestration of biomass carbon		**1190**
3. GHG emissions from pulp and paper production	120	
4. GHG emissions associated with producing virgin or recovered fibre **)	30	
5. GHG emissions associated with producing other raw materials **)	80	
6. GHG emissions associated with purchased electricity and steam *)	30	
7. Transport-related GHG emissions (excl. delivery to customer)	40	
Total fossil CO_2 emissions	**300**	
8. GHG emissions attributable to product use (e.g. printing)	-	
9. GHG emissions attributable to end-of-life-management of products	-	
10. Avoided emissions	-	

*) The CO_2 factor used for purchased power is 98 g CO_2 per kWh.
**) Since 2008 UPM is reporting data for elements 4 and 5.

Ink & other consumables

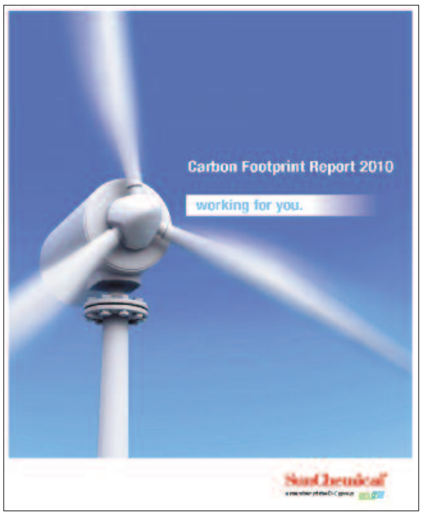
Inks: Are responsible for between 1-5% of a printed product's Carbon Footprint according to UNIC measurements. This range is influenced by the boundaries and the specific print job variables such as print process, drying/curing, and ink coverage. The European Printing Inks Association (EuPIA) identifies a range of 1-3%.

Isopropanol (IPA): IPA-free and IPA-reduced dampening solutions are broadly accepted best practice. However, some regions and sectors continue to use high levels of alcohol dampening and this will have an impact on CF.

Adhesives: There is a wide range of adhesives used in the printing and converting industries; some are solvent based and may be used in sufficient volumes to have an impact on CF.

Cleaning agents: Best practice is to use cleaning agents with a high temperature flash point to minimise evaporation in automated cleaning systems to reduce GHG and VOC emissions.

Foils: Stamping foil producers may contribute to a reduction in CO_2 by reducing raw material usage, optimizing manufacturing processes and increasing energy efficiency. KURZ has, for example, installed regenerative combustion systems that recover a large proportion of the energy required in stamping foil production.



Sun Chemical has quantified the GHG associated with the ink manufacturing and distribution phases (Gate-to-Customer Gate), as well as reviewed a number of LCAs from various sources. Report published October 2010.

Capital equipment

New technologies can provide significant reductions in energy consumption and emissions. However, the industry has relatively long reinvestment cycles, which means there will be periodic large step change improvements. Any assessment of capital equipment must take into account the operating environment, e.g. heatset plants have 'free' winter heating, unlike other processes which will require heating; digital presses normally require air-conditioning that is not an obligation for other processes. The lifetime of equipment is also critical to calculation – digital presses tends to have a life of around five years, whereas presses and postpress lines may have a lifespan of 12-25 years. Therefore the priority is to reduce energy and emissions generated during its productive lifetime which are very much higher than those generated during equipment manufacture. There are many opportunities to improve energy efficiency provided that the entire production system, its ancillaries, operating environment, and procedures are considered as an integrated system.

A recent study by the Association for Printing and Paper Technology within the German Engineering Federation (VDMA) reviews the progress of environmental, resource and energy efficiency of the printing industry in Germany and Europe during the last 10 years. *"Resource, energy and environmental efficiency in the paper and printing industry"* reports that since the year 2000, process optimisation and investments in modern process technology have enabled the reduction of energy consumption throughout Europe by 15% to a figure of 0.6 MWh per tonne of printed paper; on average 114 kg waste are generated per tonne of printed paper today and 99% of this waste is recyclable; and fresh water consumption has dropped by 44%.

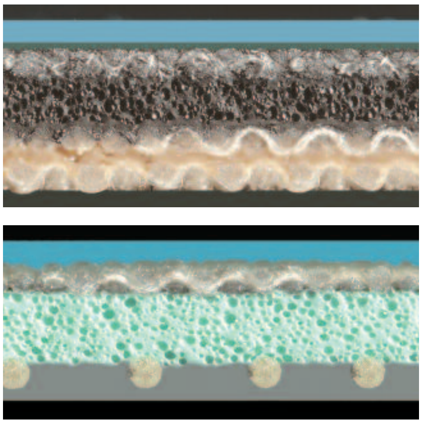
Prepress

New technologies have significantly reduced the environmental impact of prepress including their carbon and energy intensity.

Screening techniques can reduce ink consumption and related energy and carbon. This includes Under Colour Addition (UCA) or Grey Colour Removal (GCR), and the use of finer AM or FM, or hybrid screens. Tests by GATF in 2004 showed that the conventional AM 69 l/cm (175 lpi) and 25 micron FM screens both used 15% less ink than conventional AM 52 l/cm (133 lpi) screens.

'Soft' proofing systems with approved off-the-shelf LCD monitors offer proofing over the Internet to eliminate physical proofs and their related delivery, time, consumables and energy/costs that include logistics.

CTP (Computer to Plate) systems have eliminated film step to deliver a significant reduction in prepress processing chemicals and energy. This is now reinforced with low chemistry plate systems that reduce the environmental impact even further. The aluminium base of offset printing plates is recyclable into other aluminium products (automotive, construction, etc.) consume only 10% of the energy used to produce virgin aluminium.



Traditional printing blankets have a structure of a cotton fabric carcass laminated with elastomers, a compressible layer and an elastomer surface. The manufacturing process of standard solvent and rubber based printing blankets has a high environmental impact in terms of energy consumption due to the recovery systems all responsible manufacturers have in place. A new blanket technology from Trelleborg eliminates rubber and cotton fabric to significantly reduce solvent and energy during manufacture. This technology provides high print quality with a better ink transfer than conventional blankets to reduces ink and dampening solution. A more water receptive surface increases the transfer efficiency and reduces debris build-up and cleaning cycles. The polymer structure does not absorb washing solvents and none penetrate the carcass through the edges, which increases printing life to reduce the number of blankets to be purchased and disposed of. Source Trelleborg

Press and Postpress machines

Press size: The energy consumption per printed page reduces as the press format size increases. In the past 10 years there has been a significant trend to larger format presses to across all segments – sheetfed, newspaper and heatset web.

Paper handling: The ability to handle thin paper while maintaining speed and quality leads to less paper consumption which lowers the Carbon Footprint.

Digital workflow: Digital job management with a standardised JDF format increases efficiency and leads to shorter makeready time, fewer errors, less waste and down time during production. Data is also available for analysis to optimise the production.

Process reliability & stability: Higher process stability reduces waste and down time.

Direct motor drives: These are 95-96% efficient with a power loss of only 4-5% (conventional DC drives, gears, belts and pulleys are much less efficient) providing a 20-50% reduction in electricity cost depending on the application. Incorporating energy regeneration with direct drive provides even more significant savings. Drive motor cooling systems allow exhaust heat from the motors to be recovered by a connection to the joint cooling circuit of the peripheral equipment.

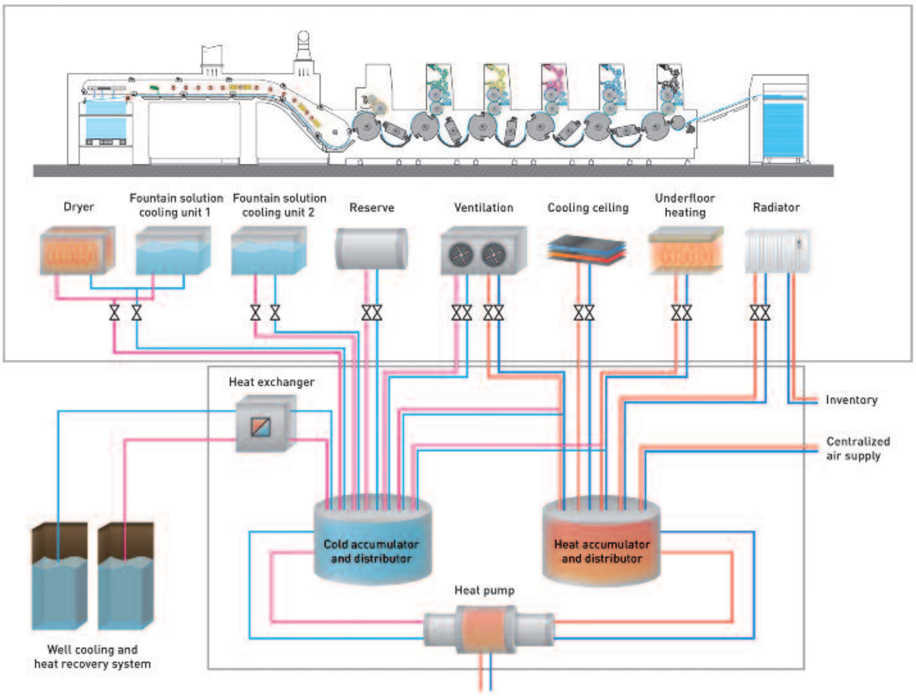
Automated operation: Fully-automated start-up sequences ensure lowest waste rates with saleable copies produced after only a few cylinder revolutions.

Inline quality control: Minimises total waste while optimising delivered quality to provide a net economic and ecologic gain.

Rollers: The right selection of components such as rubber rollers can decrease heat build-up and save energy. Poorly set rollers increase energy consumption and reduce quality. A self-adjusting roller lock-up system automatically and dynamically adjusts the roller nips. Constant printing widths of printing rollers make an important contribution to energy savings and also have a positive effect on even transfer of ink and dampening solution to the printing plate.

Blankets: Can play an important role to minimise energy in the printing unit, in some cases by up to 20% depending on its feeding and other characteristics; they can also impact the amount of dampening volume and ink consumed (with GHG impact). A new blanket technology from Trelleborg eliminates rubber and cotton fabric to significantly reduce solvent and energy during manufacture.

Optimised washing programmes: Minimise cleaning agent volume and time to clean to reduce evaporation and help reduce the GHG emissions.



The new production hall of Mehgro, Germany, has a unified design concept for energy, water, and air supply for the machinery and the building to optimise economic and ecologic performance. The integrated compressed air, well cooling, heat exchangers and heat recovery systems significantly reduce energy consumption. The under floor heating provides a stable production conditions and reduces energy requirements.

Source manroland

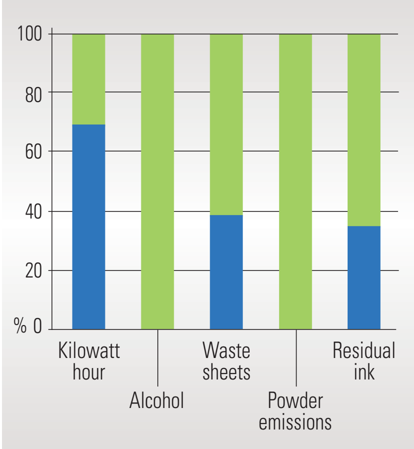
Ancillary systems: Significant energy savings are available from chilled water, compressed air, cooling units, and air supply. Water-cooled systems with waste heat recovery remove up to 50% of the total waste heat from the pressroom to an external heat exchanger; this is much more energy efficient than air cooled systems and has lower operating costs because fans and air humidifiers are avoided.

Air compressors: About 70% of electricity consumed by a compressor is turned into heat. Compressors should be sized for the required load and pressure and should draw cool air from outside the building. A variable speed screw compressor has better part-load efficiency than a machine with modulating control. Optimised system design can often reduce energy by about 30% from centralised air generation; on-demand sequence control can save 5-20%. Typically 30% of energy is lost from air leaks, requiring increased pressure to compensate; therefore, systematic maintenance is important.

Vacuum: Vacuum systems are expensive to operate and should be switched off when not required, even during job changeover. New vacuum pumps should have variable speed control. Electronically controlled operation of the vacuum suckers for separation can save energy because they are very precise, have no leakage and work only as long as it is needed for the separation process.

Sheetfed offset presses: Technologies that improve process stability and reduce waste rate include: integrated dampening solution cooling and ink unit temperature control; air supply systems with frequency modulated blowers to provide only the amount of air necessary for a given operation.
New generation curing and drying systems design have individual stepless controls to ensure energy utilisation is optimally matched with the substrates, inks and coatings used. Ink drying and curing systems can reuse up to 70% of heated exhaust air via heat feedback in the dryer circuit to increase efficiency and minimise energy consumption. IR/hot-air dryers have an optional hot-air recovery system to pre-heat dryer input air to save up to 30% of energy.

Web offset presses: Heatset drying energy consumption can be halved by using integrated regenerative thermal oxidation (RTO) to recover the energy contained in evaporated solvents during the ink drying process. An RTO has a 97% heat exchange efficiency compared to 65% for conventional recuperative technologies. Most dryer-oxidisers can be fitted with secondary heat exchangers for energy recovery to produce warm (or hot) water or electricity.
A chilled water system for each press is generally more energy efficient than a large chilling plant for multiple presses because these do not work efficiently under partial load. Closed cooling tower systems offers energy savings of up to 70% when combined with a water cooled refrigeration unit and PLC control. The automatic routing of cold water for the chill rolls through an outdoor chilling unit when the external temperature drops below 10°C can considerably reduce energy draw and often has an ROI of less than one year.



Reduction of consummation possible with advanced sheetfed press technologies.
Source manroland

Postpress

Although postpress generally contributes less than 2% of the total Carbon Footprint of a print product, it can contribute in different ways to reduce overall emissions and energy consumption. Some postpress specific points include:

Format size: Smaller trims between printed format and signature format will reduce paper consumption (e.g. cutting only a few millimetres in a three-knife-trimmer).

Glue: Melting glue uses a significant ratio of the total energy consumed by a perfect binder. Electrical energy demand can be reduced by using PUR instead of hotmelt; and/or glue nozzles (instead of conventional roll application) to reduce amount premelted glue needed.

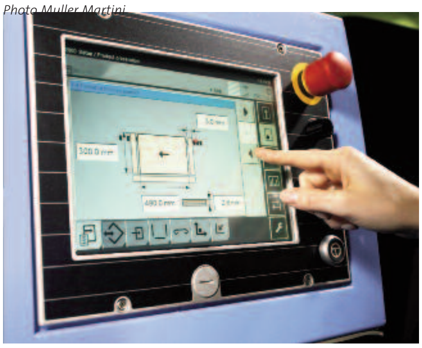
Infrared dryer: Adjusting the type of IR Dryer to the absorption spectrum of the material that has to be dried or heated will save energy, as will dimming the dryer in relation to the production speed, and by switching it off during production stops.

Inline finishing: In general, the fewer manual interruptions between different sub-processes are the more energy efficient the process is. Energy efficiency per finished product rises and paper waste declines with every pass through the press that is saved. Inline finishing of sheetfed, web print and digital products offers high potential savings of energy consumption, paper waste and logistics.

Maintenance: Regular preventive maintenance is essential to ensure energy efficiency. Remote access diagnostics allows faster reaction from the equipment manufacturer without travelling and can save money, time and preserves the environment.

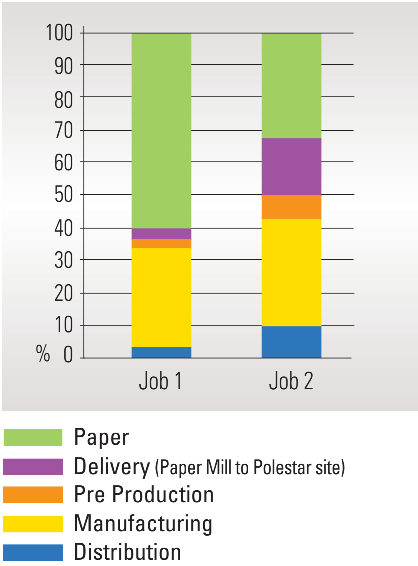
Operator Training: Well trained operators help to reduce makeready-time, waste and down time during production.

Makeready set-up wizards can optimise production to reduce waste of time, paper and energy. Continuous data flow through a Connex workflow system provides information to automatically preset machines with an Amrys like control.
Photo Muller Martini



Case studies

Publication Printing



A Polestar Carbon Footprint calculation of two different jobs showing the relative proportions of each that can vary significantly. Source Polestar

The Polestar Company Limited, UK

Gary Marshall, Group Risk Manager, shares some experience as an early adopter of carbon and energy reduction activities.

Carbon management started in the UK in 2000 with a new tax called the Climate Change Levy. This encouraged Polestar to analyse its energy consumption and begin to look at its carbon profile. It quickly became clear that many different calculations made no sense and a more integrated system was necessary. This led to the first version of our carbon calculator to give us a more holistic approach to our supply chain. We are getting better at identifying key aspects and seeking the information needed to commit to carbon footprints – whether overall figures, site energy equivalents, site overall aspects, or per job calculations. Our aim is to create a calculation for the total supply chain on each finished product. We are on track for a 16% energy reduction through 2010.

A single industry value chain approach is absolutely critical. We must get to a stage where our industry has a single agreed methodology with open source and shared information. What is the cost of having consultants hide away numbers, including some gathered from industry, to promote their own business? Better to agree the methodology in the industry, and release figures for use amongst ourselves. To measure results we must have consistency in the calculation methods and this is not the case at present. This is critical when we are being required to achieve carbon savings of 30-80% from 2020 to 2050.

The printing process uses most energy, and new technologies and allied working practices are needed to make it more carbon efficient. Plans need to be both strategic and plant macro- and micro-related with adequate discussion to agree the right actions. We need to see a payback that is clearly in our bottom line for energy cost reduction. This ranges from the small day-to-day aspects (lights, heating, motors) though to the larger investment items (new presses), and to strategic issues (benefits or otherwise of CHP, Wind Turbines).

We define the 3 key success factors to optimise carbon and energy consumption as:

1. Good visionary thinking on what to include.
2. Gathering champions and making our vision work.
3. Clear direction and Board support.

Packaging & converting

Sun Chemical/Environ Consulting

Case 1: The operations of three European business units of an international packaging company were reviewed for their purchased energy and carbon emissions, energy management practices, and to identify technical opportunities. The group prints and converts folding cartons, composite tubes, labels and specialised packaging products for food, confectionary and tobacco industries. The audit included boiler plant and controls, steam distribution/condensate return, space heating, hot water systems, compressed air, vacuum, lighting and building fabric. The results from improvements were a reduction of 19% in energy costs and 17% of GHG emissions. The return on investment was 1.6 years.

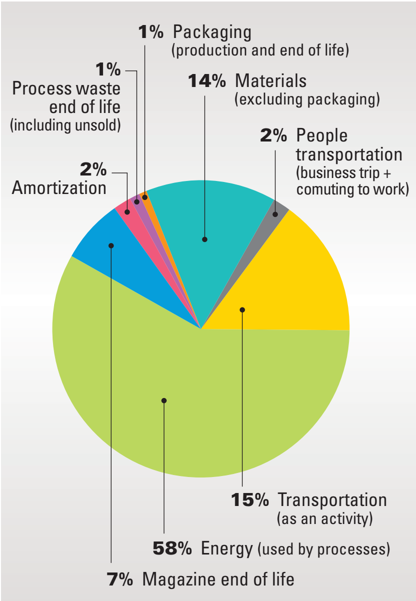
Case 2: A sheetfed printer converter of board and paper using three production lines with 140 employees had a total energy and water cost of €500,000/year with carbon emissions of 2715 t CO_2/year. Following an energy and site audit that identified a range of management and technical measures, these figures were reduced by 13% in energy costs (€65,000/year) and 13% less carbon emissions. The capital cost requirement was €55,000 with a payback on investment in 11 months.

Magazines Publishing

FIPP/FAEP Magazines and the Environment Handbook 2009

Publishers who have been through the process of attempting to calculate their carbon footprint agree on a number of key points:

- It is important to show decision-makers within the organisation that there is sound economic evidence for calculating the carbon footprint and making changes based on it
- It is likely that the calculation will need to go through more than one pilot process in order to perfect it
- Information and transparency about processes are key to getting buy-in from all the suppliers who are participating in the exercise. An appointed project champion is required to get the project going and keep up the momentum.
- Beware of vested interests within the supply chain.
- A third party audit is crucial for the credibility of the project.
- If all parties are signed up to environmental management standards schemes such as ISO 14001, this provides a good basis for dialogue.
- There should be an integrated approach. A virtuous circle of measurability, monitoring, reporting and continuous improvement will ensure maximum benefit.
- According to the experience of publishers who have already measured their carbon footprint, the majority of emissions in the publishing process are likely to come from paper production, with smaller amounts contributed through the printing and editorial processes.



VSD magazine's carbon footprint breakdown.
Source Sun Chemical

Prisma Publishing, France

The weekly French news magazine VSD, published by the Prisma Publishing Group, owned by Gruner & Jahr (Bertelsmann Group) made an extensive calculation of the carbon footprint of a magazine from its conception to the retail kiosk. To make this comprehensive assessment, expert partners were involved from UNIC, Stora Enso, UPM, Sun Chemical, Circle Printers, Brofasud Binding, NMPP Presse Services and La Poste.

Some of the resulting specific action plans:

- Logistics reform and transport mutualisation study.
- Cogeneration from recycling calories on the steam circuit at the print plant.
- Installation of ultracapacitors.
- Automatic shutdown devices that turn off machine air-supplying systems after two minutes of standby.
- Industrial waste sorting and valuation intensification.
- Use of high density ink and non-penetrating varnish.
- Extension of ink bulk supply to reduce logistics/transport related emissions.
- Cut in paper spoilage.
- Office waste sorting and people-consciousness-raising.
- Use of green couriers.

Text printing & Binding: Augsburger Druck-und Verlaghaus, Augsburg
Inks: Sun Chemical
Paper: sappi Royal Roto Brilliant+ 115 gsm

Cover printing: ROLAND 506 LV Prindor, manroland Print Technology Center, Offenbach
Coldfoil: LEONHARD KURZ, KPS series
Paper: M-real Carta Integra 250 gsm

Design and page make-up: ID-industry, Paris

The materials used in this guide (including cold foil, inks and coatings) allow the paper fibres to be fully recycled.

KURZ

MEMBER www.kurz.de

KURZ, as a globally-active supplier of stamping foil technology, has set itself the challenge of continuously optimizing its manufacturing processes to minimize the environmental impact of its operations. Through savings in raw material usage, increases in energy efficiency, and optimization of manufacturing processes to eliminate waste, KURZ reduces CO_2 emissions. By modifying the lacquer systems used for its graphical products, for example, KURZ now uses 13% less solvent than in its 2003 formulations. Thanks to the installation of state-of-the-art production machines, KURZ is able to reduce the total energy consumption for stamping foil production on these new machines by around 23%. Furthermore, KURZ achieves a high energy efficiency, through the use of regenerative combustion systems at all its locations worldwide.

manroland

MEMBER www.manroland.com

manroland is one of the leading manufacturers of sheetfed and web offset presses, and also provides digital inkjet printing solutions, that offers its customers groundbreaking technologies to increase their profitability while improving their ecobalance. manroland is committed to using an environmental management system and all its sites are certified in accordance with ISO 9001. The Augsburg and Plauen sites have additional certification to ISO 14001. The Augsburg operation became a member of the environmental pact in Bavaria in 2000, and participated in the Ökoprofit project for the city of Augsburg in 2003. In 2007, the Offenbach location received the Highlight Award from the Ministry of the Environment in the German state of Hesse. The company has also invested in energy efficient equipment and building technology.

m·real

MEMBER www.m-real.com

M-real is one of the leading producers of paperboard and paper in Europe. M-real Consumer Packaging's portfolio includes paperboards for packaging and graphics applications, wallpaper base and speciality papers for flexible packaging, labelling and self-adhesive laminates. M-real is focusing on high-performance lightweight paperboards based on primary fibres from sustainably managed forests and produced in mills holding ISO 9001 and 14001 accreditation and PEFC/FSC C-o-C. Carbon Footprint calculations for all products are available through its parent company, Metsaliitto, who is a member of the World Business Council for sustainable development (WBCSD), forestry group, a global organisation focussing on sustainable development for business.

MKW

MEMBER www.mkwgmbh.com

MKW produces inline production systems for collating printed sets up to complete production lines for calendars, brochures and booklets in various format sizes. The company offers a wide range finishing equipment to produce many different types of products and jobs with integrated units. MKW also makes special machines for the offset and packaging industry where they offer rapid and practical solutions. Energy efficient and environmentally friendly concepts are reveiwed and implemented for every new design. PC controlled systems for needs oriented production are standard for many years and they effectively contribute to saving energy and the reduction of CO_2 emissions.

PROJECT PARTNER www.mullermartini.com

MÜLLER MARTINI

Müller Martini is a globally active Swiss-based group of companies who are leaders in the development, manufacture and marketing of a broad range of print finishing systems. Since its foundation in 1946, the family owned business has created innovative products exclusively tailored to the demanding needs of the graphic arts industry. The company's seven business sectors are: Industry-first Digital solutions; Web offset presses; Press delivery (conveying, trimming, bundle and log forming, palletising, roll systems); Saddle stitching systems; Soft cover production; Hard cover production; Newspaper mailroom systems. The focus on saving carbon footprint and energy is set to resource and electrical energy reduction through automation, continuous process improvements and waste reduction. Muller Martini is partner in the Swiss national Carbon Footprint Reduction Program.

MEMBER www.sappi.com

sappi
The art of adding value

Sappi is the world's leading producer of coated fine paper. Sappi offers a broad range of products, which comprises many of Europe's leading paper brands: Galerie, Galerie Art, Era, Magno, Royal, Tempo, Cento, Furioso, Quatro and Tauro, as well as Algro, Leine and Parade speciality labelling and packaging papers and boards. The papers are produced in mills accredited with ISO9001, 14001 and in the EU with the EMAS certification. Sappi was the first paper company in Europe to hold group chain-of-custody certification for its entire European operations under both the Forest Stewardship Council (FSC) and the Programme for the Endorsement of Forest Certification (PEFC) schemes. Sappi supports print, the most tangible, sustainable, portable and efficient medium for advertising and promotion.

MEMBER www.sunchemical.com

SunChemical®
a member of the DIC group

Sun Chemical is the world's foremost producer of inks, pigments and colour technology. The company is leading the industry in developing products to minimise the impact on the environment and the maximum use of renewable resources. Sun Chemical has a sustainability policy based on the metrics of resources and economy that are the two pillars of sustainability. The company's products and services can help conserve energy, reduce carbon footprint, uses renewable / bio-based resources, do not impact product recyclability / compostability, use low or no VOCs in manufacture, and reduce waste. We continue to invest in research and development to develop products that meet the needs of the present but also consider the needs of our future generations.

MEMBER www.trelleborg.com

TRELLEBORG

Trelleborg has improved its environmental performance by better resource management, reduced production waste, increased recycling, and implementing mandatory energy savings plans. Trelleborg was again selected for the 2008 Dow Jones STOXX Sustainability Index that identifies leading companies in the area of sustainability. Since 2007, Trelleborg has participated in the UN Global Compact network, an initiative for responsible business practices. Printing blanket manufacturing sites in Europe, China and the US are ISO 14001 and ISO 9001 certified. An ambitious KAIZEN pilot project has begun in Italy to improve production and reduce waste, and the French site has initiated a Carbon Footprint analysis to benchmark solvent free blanket production in energy consumption vs. solvent based blankets.

MEMBER www.upm.com

The Biofore Company UPM

UPM – The Biofore Company – leads the integration of bio and forest industries into a sustainable and innovation future. The Group is a leading producer of printing and publication papers, pulp, timber, engineered wood materials and low carbon energy. UPM strives to manage its part in the lifecycle and challenges everybody in the production chain to reduce the environmental impact over the entire product lifecycle. This includes sustainable and traceable fibre sourcing, efficient use of water and energy, air and wastewater emissions that reflect best practice and a high rate of recycling and reuse of solid waste. UPM is included in the Dow Jones Global Sustainability Index and Carbon Disclosure Project Leadership Index for the Nordic Region.

REDUCTION

Carbon Footprint & Energy Reduction

for the graphic Industry Value Chain

sappi
The art of adding value

The Biofore Company

connection of competence