technicolor

ENVIRONMENTAL CONSIDERATIONS

WHITEPAPER

APPLIED THROUGHOUT THE LIFECYCLE OF
ADVANCED CUSTOMER PREMISES EQUIPMENT

JANUARY 2010

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GROUP OVERVIEW

Technicolor, a leading worldwide provider of services for content creators, also develops and supplies a wide range of devices and applications through its Connect Division that facilitate the delivery of content both within a subscriber's premises (residential or business) or via a service provider's network, providing voice, video, data, and other related services. Examples include residential and business gateways, set-top boxes (STBs), modems, and telephony and multimedia devices.

Within the Customer Premises Equipment (CPE) marketplace, Technicolor's Connect Division holds a leading position, earning revenues of around 1.5 billion Euros worldwide in 2008, and shipping over 16 million gateways and 15 million STBs in the same year.

In most instances, STBs and residential or business access devices are developed by Technicolor in close conjunction with each Network Service Provider (NSP), ensuring that the right balance of functionality, operational convenience and cost is achieved to meet each operator's specific business goals.

ENVIRONMENTAL CONSIDERATIONS LIE AT THE HEART OF TECHNICOLOR'S STRATEGY

As a global leader in the provision of a diverse range of communication and video technologies, finished products, systems, equipment, and services to businesses and professionals in the entertainment and media industries, Technicolor has long maintained a positive stance towards environmental issues across the development, manufacture, use and ultimate disposal of its products. To formalize this core philosophy, Technicolor first initiated a Corporate Environment, Health and Safety (EH&S) Charter in 1992. This EH&S Charter, revised and updated in 2005, is supported by the Technicolor Ethics Charter and the company's Corporate Social Responsibility Approach.

The EH&S Charter defines guidelines for key management principles that are designed to protect human health and the environment, helps us meet our legal and corporate responsibilities, and allows us to coordinate activities and operations across all our locations.

As environmental understanding and supporting technologies have grown, so too has Technicolor continued to develop this charter. Technicolor has implemented a number of tools and systems for product lifecycle management, including initiatives such as its contribution to the definition of the Lifecycle Assessment Tool called EIME[1] which is implemented as a standard by several electrical and electronic industry players in Europe.

In addition, the Connect Division has gone even further by developing its own environmental product policy. The following paragraph explains how this specific division is currently adopting a pioneering approach in this domain.

1 EIME is a LCA tool developed by Bureau Veritas CODDE

ENVIRONMENTAL ASPECTS OF THE CONNECT DIVISION'S ACTIVITIES

As Connect Division deals with the manufacture of network access devices and products on a daily basis, it strives to take into account its environmental impact.

As part of its own strategy, the Connect Division has issued its own Environmental Product Policy (EPP) to ensure that not only regulations and standards are respected wherever the company operates around the world, but that environmental considerations are recognized as crucially important by every employee.

Connect Division is committed to best practice - not just achieving compliance with minimal standards

More specifically, the Connect Division's Environmental Product Policy commits the organization to:

– Comply with all the laws, regulations and industry guidelines endorsed by Technicolor. These include the European Union Code of Conduct on Energy Efficiency of Digital TV Service, and Energy Consumption of Broadband Equipment.

– Constantly monitor environmental impacts through the management and control of hazardous substances and through waste reduction.

– Constantly improve environmental management through regular audits.

– Work with its suppliers to further drive environmental improvements.

– Improve the environmental performance of its operations by better managing the entire lifecycle of electrical and electronic equipment.

In the following sections, our aims are to show how the Connect Division is fulfilling its commitment to concrete environmental responsibility.

Our commitment to fully comply with laws and regulations for electronic products

The European Union uses several regulatory tools to apply responsible life-cycle strategies to product development and reduce the environmental impact of products. Relevant legislation includes bans on chemicals (REACH, ROHS, Batteries Directives), waste and recycling (WEEE and Batteries Directives) and energy efficiency (EuP Directive).

REACH (Registration, Evaluation and Authorisation of Chemicals)

As part of its efforts to expand its environmental control procedures, the Connect Division works alongside industry partners on new European Community regulations on chemicals and their safe use. Amongst these initiatives, REACH is designed to ensure that manufacturers and importers gather information on the properties of the chemicals they use to better protect the environment and manage risks to human health. The solutions under development by our task force will enable us to track and control the use of all chemicals from suppliers and sourcing partners at every level of the company, gathering on-site data and worldwide business units' needs.

CONNECT DIVISIONS SCOPE OF ACTIONS

The RoHS Directive: Restriction of Hazardous Substances 2002/95/EC

The RoHS Directive's key provision bans the use of six substances in electrical and electronic equipment (EEE) in concentrations that exceed the maximum limits. The six substances are lead, mercury, cadmium, hexavalent chromium, polybrominated biphenyls (PBB) or polybrominated diphenyl ethers (PBDE). The RoHS regulations, also developed by the European Union, provide stringent guidelines for manufacturing.

The RoHS regulations called for major changes in manufacturing processes. The Connect Division was fully compliant with RoHS ahead of the 2006 deadline, not just in its own plants but in all those of its subcontractors worldwide.

The RoHS Directive is currently being reviewed and Technicolor is following this process closely. Technicolor's current list of controlled and banned substances has already been updated with four hazardous substances identified for priority assessment and possible future banning.

The WEEE Directive: Waste Electrical and Electronic Equipment (2002/95/EC)

The WEEE Directive relates to waste electrical and electronic equipment by setting collection, recycling and recovery targets for all types of electrical and electronic goods.

It requires manufacturers, importers and distributors of electronic equipments to affix a symbol, indicating that their products are subject to selective collection, to register in each Member State under the laws in force for the implementation of the WEEE Directive, and to support the recycling of electronic products at the end of their lifecycle. Implemented on August 13th, 2005, the Connect Division has undertaken to respect the terms of the WEEE directive as it is implemented in each Member State. Following the measures required, the Connect Division has complied with the re-labeling of its products for the European market, and has been registered in countries where it has a responsibility - to date Belgium, France, Germany, Italy, Spain and the U.K.

The WEEE Directive is currently being reviewed.

The New Battery Directive (2006/66/EC)

The New Battery Directive is aimed at minimizing the negative impact of batteries, accumulators and their waste on the environment. It also requires that manufacturers design products in such a way that batteries and accumulators are easily removable with instructions for the end-users on how they can be safely removed. Batteries must also be labeled to show the crossed-out wheeled waste bin. In addition, the new directive requires that producers and importers of batteries and appliances incorporating batteries themselves finance the cost of collecting, treating and recycling waste batteries and accumulators.

The EuP (Energy Using Products) Directive (2005/32/EC)

The EuP Directive is a "framework directive" for the establishment of ecodesign requirements for such products. Products are not to be subject to ecodesign or energy efficiency requirements until implementing measures have been issued. Under an implementing measure, manufacturers are required to perform an assessment of the environmental aspects of their products. The first of these measures on Standby and Off-Mode (1275/2008/EC) will come into force in January 2010. The Connect Division has already implemented the measures on standby and off-mode in its products.

Other requirements are related to ecodesign for no-load condition electric power consumption and average active efficiency of External Power Supplies (278/2009/EC) and ecodesign standards for Simple set-top boxes (107/2009/EC). The Implementation Measure for Complex set-top boxes is next in the pipeline and Technicolor is highly involved in these discussions.

Other International Regulations

From an international point of view, Asia-Pacific governments have also promoted environmental laws and technical standards over the past two years. The greatest concern is focused on the development of the China WEEE and China RoHS, developing similar or even more stringent requirements than the EU RoHS and WEEE regulations. Electronic products marketed in North America are also subject to an expanding patchwork of product-based environmental legislation such as material restrictions in California, product recycling and take-back laws.

Countries all over the world (Australia, Canada, China, USA, etc) are also developing national programs for energy efficiency – The U.S. Federal Energy Independence and Security Act of 2007 (EISA) has requirements for external power supplies and set-top boxes which are already met by the Connect Division's products.

These trends are expected to continue for the next several years and the Connect Division is committed to monitor and manage all environmental requirements as ecodesign is at the very heart of Connect's strategy.

Our participation in voluntary agreements to enhance lower power consumption of our products

One of Technicolor's corporate values is a commitment to globally agreed voluntary agreements. Technicolor maintains representation on international environmental and safety standards-setting bodies, just as it does on the relevant engineering committees.

Connect engineers who are members of Technicolor's International Ecodesign Task Force have served on several international boards focusing on energy consumption standards, endeavoring to draw together the work carried out in this respect in Europe, the U.S., Canada, China and Australia. As already noted, to improve best practice in its broadband access product portfolio, Technicolor is taking a leading part in the group working on the European Union Code of Conduct for energy consumption in Broadband Equipment and Digital Television Service Systems.

The Connect Division has engineers who are taking a leading role in the Energy Efficiency Task Force of HGI, the Home Gateway Initiative.[1]

HGI is an open forum launched by telecom operators in 2004 with the aim of coordinating and releasing specifications for home gateways. Technicolor is very active in this group as a gateway vendor.

Externally, there has been an increased drive towards good practice through voluntary codes such as Energy Star in the United States and the European Union's Codes of Conduct on the energy efficiency of Digital TV Service Systems and Broadband Equipment.

Technicolor was an early signatory to the EU's Codes of Conduct on the energy efficiency of Digital TV Service Systems and the energy consumption of Broadband Equipment. The Codes were signed by Technicolor in May 2008, committing the company to develop and bring to market products which comply with stringent energy efficiency levels. They also commits Technicolor to report to the European Commission annually, providing information about the power consumption of equipment covered by the Codes of Conduct, so allowing the Commission to monitor the effectiveness of its program. On the CPE level, Technicolor was the first CPE vendor to sign the Code of Conduct for Broadband Equipment, putting itself in a leading role for low energy consumption Residential Gateways.

Though already compliant for a number of years, in 2009 Technicolor engaged in the formal process of Energy Star[2] registration for its set-top boxes. As an early follower of the Set-Top Box program, Technicolor with its Connect Division, wishes to see its efforts to design best-in-class products officially recognized through the Energy Star ecolabel. This will be done in the course of 2010 as registration is a long and formal process.

1 http://www.homegatewayinitiative.org/aboutus/TF/Energy/Index_Energy.html

2 It is an international standard for energy efficient consumer products. It represents the level that any manufacturer wishing to protect the environment must meet.

Our Suppliers' involvement

As part of its code of ethics[1] and its procurement policy, the Connect Division has a comprehensive set of guidelines which cover every aspect of the environmental, health, and safety policies of every factory that contributes to its products - whether it is a Technicolor plant or a supplier's. These policies are designed to ensure that everything within the finished product is produced according to best practice and is fully conformant with Technicolor's Code of Ethics. Complementing this, we have statements of work in place with our suppliers to ensure that they are also compliant with the Code of Conduct.

The products themselves are made in accordance with all applicable laws and without the use of selected, restricted and controlled hazardous materials, and comply precisely with their aim of being energy efficient in use.

This involves Connect's specialists visiting suppliers to conduct a "green audit" of every manufacturing plant. The audit will validate the plant's own compliance assurance system by spot-checking the plant, the manufacturing cycle, and the components and materials used.

In cooperation with its key suppliers, Technicolor is committed to pushing the boundaries of technology to achieve better stewardship of the environment while continuing to bring innovative products to market.

Random sampling checks include the use of advanced diagnostic techniques - such as X-ray fluorescence - which can detect the presence of banned or restricted substances. The audit team reserves the right to perform destructive testing on any sub-assemblies it believes do not meet Technicolor's exacting standards.

These tests, along with safety compliance tests, are performed on production run units selected at random, not prototypes.

In addition to the components, sub-assemblies, or products being investigated, the audit will also consider the factory within its own environment. It will look at important environmental issues such as power consumption, water usage, and the management of waste and potential pollutants. We strongly encourage our suppliers to meet ISO 14001 practices.

In summary, Connect's suppliers should minimize their impact on the local and global environment by restricting their draw on resources such as energy and water, and by managing waste so as to eliminate pollution and reduce as much as possible landfill waste.

1 http://www.Technicolor.net/GlobalEnglish/Corporate/About/corporate-social-responsibility/Pages/Ethics-Human-Rights.aspx

ECODESIGN AS A KEY BUSINESS ADVANTAGE

Consumer's environmental awareness is also growing and many purchasers take environmental criteria into account when making buying decisions. Responsible consumers will also want to be reassured that vendors are taking all steps possible to ensure that the best environmental practices are applied at every stage of manufacture and delivery.

Increasingly, Technicolor's direct customers, broadcasters and service providers are making good environmental practice a part of their contract terms - or at least are engaging in a dialogue on the subject. Clearly, good "green" design is important to everyone.

Inevitably, meeting expectations of good environmental stewardship involves some changes, at least in design and manufacturing. For example, to be able to guarantee that an electronic design is as energy efficient as possible, its developers have to investigate every other possible design.

But ecodesign also involves impacts on costs, product functionality, user habits, and service implementation. It is only when a win-win situation can be demonstrated that all parties will buy into the best design practices. This win-win situation must be met between the end-user, the service provider and the manufacturer.

To achieve these environmental objectives, green product lifecycle management needs both methodologies and tools.

Ecodesign principles & methodology

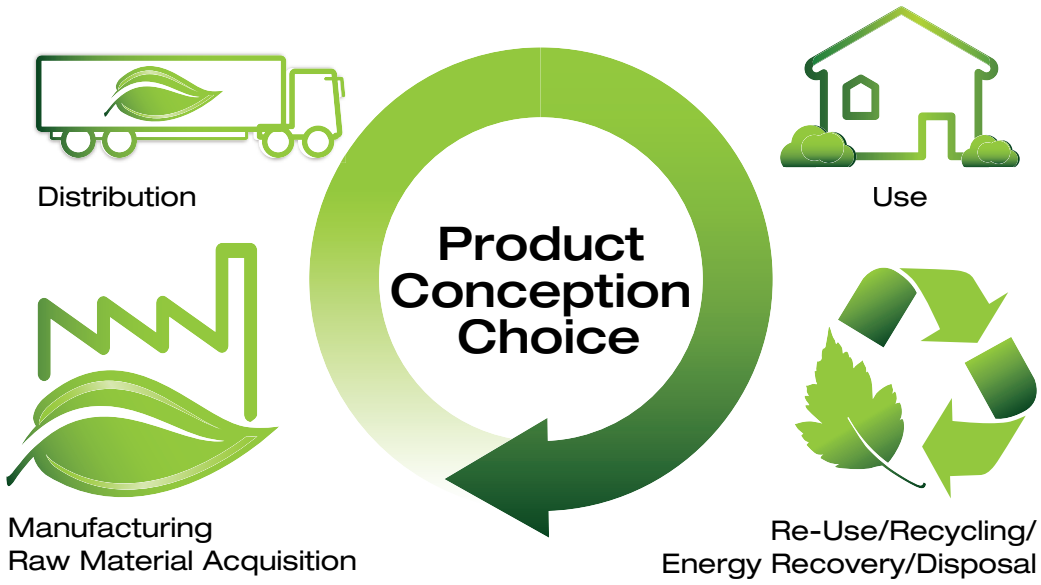
Ecodesign is an activity that integrates environmental aspects into product design and development. This involves the integration of environmental issues in the design process of products (without compromising their level of quality and performances) and into an entire product lifecycle approach. Ecodesign therefore includes all environmental regulations and specific environmental product requirements including the expectations of the customers.

ISO/TR 14062 covers practices and methodologies relating to the integration of environmental aspects into the product design and development process. It describes from the beginning through to market launch examples of inputs and outputs for each phase and the tools that need to be applied. For each product lifecycle state (planning, conceptual and detailed design, testing and prototyping, product market launch, product review, etc.), the actions to be performed to design a product have to be compliant with the product's environmental target specifications. This ecodesign methodology will be merged in ETM (Early-to-Market), which is the Technicolor-specific product development scheme and then deployed over 2009-2010 across Connect's product development sites.

Ecodesign principles & tools

To support the ecodesign process, Life Cycle Assessment (LCA) tools are needed to identify and measure the environmental impacts of a product during its entire life (i.e. from the cradle to the grave). Connect has selected the EIME tool which is considered as the reference LCA evaluation tool for electronic and electrical equipment. It measures 11 environmental impact indicators such as global warming (i.e. CO_2 footprint), water eutrophication, resource material depletion, etc, which allow Technicolor's Connect Division to evaluate, compare, improve and communicate product design and environmental performance.

FIGURE 1 : PRODUCT CONCEPTION CHOICE ACCORDING TO PRODUCT LIFE CYCLE STAGES



The graph below (figure 1) shows the environmental impacts of a product across its lifecycle. It shows that for an STB type of product:

– The Use phase is the most important contributor to 8 indicators out of 11 – This represents around 80% of all other environmental indicators, including the GW (Global Warming) indicator which defines the product's carbon foot print.

– The Manufacturing phase represents 98% of RMD (Resource Material Depletion) which calculates the depletion of natural resources and 52% of the WT (Water Toxicity) indicator.

– The Distribution phase has a very small impact due to boat transportation

– except for WE (Water Eutrophication) caused by cardboard packaging.

– End-of-life treatments are not responsible for any significant environmental impact. This phase mainly has some impact on Water Toxicity (WT) and WE (Water Eutrophication).

This type of impact distribution, where the main environmental impact is provided by the use phase, is generic to all STBs and home gateways and, more generally, to ICT devices powered by mains electricity .

The other graph 1.1 below shows the impact distribution of a VDSL home gateway.

Creating the ability to assess all the environmental impacts that a product may have at every stage of its lifecycle - from its first definition and design to its disposal at the end of its life - will be the next critical element in Connect's sustainable product development strategy.

RELATIVE LIFECYCLE IMPACTS DISTRIBUTION

		Example of a Technicolor Cable set-top box					Example of a Technicolor Home Gateway					
Indicator	Unité	Total	Manufacturing	Distribution	Use	End of life	Unit	Total	Manufacturing	Distribution	Use	End of life
RMD - Raw Material Depletion	Y-1	4,35E-13	98,49%	0,00%	1,50%	0,01%	Y-1	2,95E-13	99,00%	0,00%	1,00%	0,00%
ED - Energy Depletion (energy consumption)	MJ	6284,883908	6,88%	0,39%	92,55%	0,18%	MJ	3009,25	10,60%	0,40%	88,90%	0,10%
WD - Water Depletion (water consumption)	dm3	1151,513988	19,72%	1,95%	78,11%	0,22%	dm3	604,71	30,50%	1,00%	68,40%	0,10%
GW - Global Warming (CO2 footprint)	kg ~CO2	326,1367399	7,87%	0,17%	91,14%	0,82%	kg ~CO2	156,66	12,00%	0,40%	87,30%	0,30%
OD - Ozone Depletion (ozone consumption)	mg ~CFC-11	30,76502102	15,30%	0,99%	83,13%	0,58%	mg ~CFC-11	16,5	26,60%	1,80%	71,30%	0,30%
AT - Air Toxicity	m3	6,30E+07	8,49%	0,31%	90,94%	0,26%	m3	3,00E+07	12,00%	0,90%	87,10%	0,10%
POC - Photochemical Ozone Creation	g ~C2H4	111,7032016	6,97%	0,39%	92,34%	0,30%	g ~C2H4	54,07	11,40%	0,70%	87,80%	0,10%
AA - Air Acidification	g ~H+	51,52955104	8,19%	0,29%	91,29%	0,23%	g ~H+	24,75	11,70%	0,80%	87,40%	0,10%
WT - Water Toxicity	m3	108,5496299	4,82%	0,31%	66,56%	28,30%	m3	38,43	10,60%	0,30%	86,50%	2,50%
WE - Water Eutrophication	g ~PO4	2,807309955	52,76%	5,26%	30,24%	11,74%	g ~PO4	1,37	63,80%	3,20%	28,40%	4,60%
HWP - Hazardous Waste Production	kg	5,626630645	15,68%	0,01%	84,19%	0,12%	kg	2,78	21,70%	0,00%	78,30%	0,00%

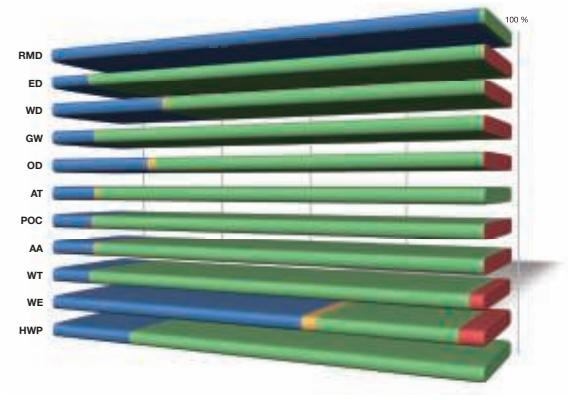


Figure 1:
Relative lifecycle impacts distribution of a STB

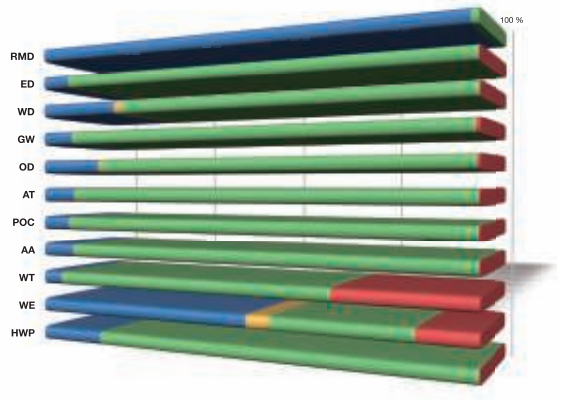


Figure 1.1:
Relative lifecycle impacts distribution of a Home Gateway

LIFE CYCLE ASSESSMENT: THE MANUFACTURING STAGE

Designing and manufacturing a complex electronic device, such as a set-top box (STB) or an access gateway, involves balancing a number of factors:

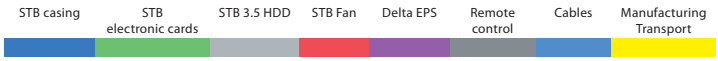
- Performance
- Reliability
- Cost
- Power
- Consumption
- Future expandability (see section 5)
- Customer expectations
- Functionalities and end-user satisfaction
- Product LCA impacts
- Various environmental regulations and voluntary initiatives (see section 2)

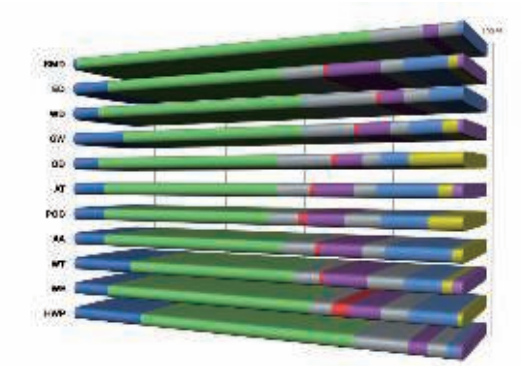
First, as previously demonstrated in Figure 1, the easiest and most efficient approach to minimize the environmental impact of an STB is to reduce its power consumption. There are a number of different ways to tackle this issue and Connect has specifically invested in the areas that are developed in the Use Stage section.

The manufacturing phase of a STB has its own environmental impact and reducing Raw Material Depletion (RMD) and Water Eutrophication (WE) impact indicators are expected to act on the manufacturing phase. This means on the product design itself. Figure 2 gives the distribution of impacts across the main components of a PVR STB.

FIGURE 2: DISTRIBUTION OF IMPACTS ACROSS THE MAIN COMPONENTS OF A PVR STB

Contributor	STB casing	STB electronic cards	STB 3.5 HDD	STB Fan	Delta EPS	Remote control	Cables	Manufacturing Transport
RMD	1 %	80 %	11 %	0 %	3 %	4 %	1 %	0 %
ED	11 %	49 %	10 %	1 %	12 %	5 %	9 %	2 %
WD	8 %	57 %	17 %	1 %	5 %	5 %	8 %	0 %
GW	16 %	49 %	12 %	1 %	7 %	4 %	7 %	3 %
OD	8 %	51 %	13 %	1 %	6 %	4 %	6 %	11 %
AT	10 %	49 %	8 %	1 %	9 %	5 %	13 %	3 %
POC	10 %	47 %	7 %	2 %	9 %	8 %	10 %	8 %
AA	10 %	50 %	8 %	1 %	10 %	5 %	14 %	3 %
WT	18 %	45 %	6 %	1 %	10 %	8 %	8 %	2 %
WE	11 %	56 %	5 %	4 %	7 %	6 %	10 %	1 %
HWP	21 %	56 %	12 %	0 %	4 %	4 %	2 %	0 %
average on all indicators	11 %	54 %	10 %	1 %	7 %	5 %	8 %	3 %





Choosing the best components and design concept

Connect's R&D engineers work closely with suppliers of components such as chips and disk drives, encouraging them to develop components which meet the specific needs of access products. Dedicated chipsets minimize the number of components needed to achieve functionality which also reduces the global power consumption and the RMD caused mainly by semiconductors.

The ability to turn off parts of the processor - or even ancillary circuitry - when not required can contribute to very worthwhile energy savings. This is one of the main factors influencing the choice of the key components.

Moreover, efficient electronic design is best served by an orderly start-up which powers-up components and sub-assemblies in the right order. This helps to minimize transient demands on the power supply.

WIRELESS VOIP RESIDENTIAL GATEWAY WITH INTEGRATED DECT HANDSET

A good example of the ways in which Technicolor is minimizing the environmental impact of its products involves the integration of a DECT base station into a DSL residential gateway providing IP telephony. Compared to an external DECT telephone, incorporating a DECT base station in the gateway cuts down on the materials used as resources are shared: the same casing, the same power supply, and the same CPU. Furthermore, the internal interface between the VoIP client and the DECT base station allows operators to provide end users with additional VoIP services. Compared to a two-box solution where the DECT phone is associated with a VoIP-enabled residential gateway, the integrated platform architecture calls for significantly fewer electronic components - thus leading to welcome energy savings.

One example is the TG797n the world's smallest gateway with an integrated DECT handset, which shows an optimized design with a much reduced use of plastic materials as well as an ECO button to reduce power consumption. The product features, as do all high end Technicolor products, a WiFi sniffer, a detection mechanism for wireless clients. When there's no client detected, the wireless goes off for a period of time.

A good example of efficient hardware design involves the hard disk drives. The life of a hard drive can be affected by powering it up and down too often and, of course, extra power is needed to bring the disk from a stopped state up to operating speed. The relative power consumption of leaving the disk spinning compared with shutting it down will need to be balanced and set against any reduction in the likely reliability of the disk.

The number of front panel lights and displays may evolve in the future, linked of course to the consumers' own behaviors and their changing expectations. For instance, some markets still feel that a lot of bright LEDs on the front panel demonstrate to the consumer how sophisticated a device is. The problem is obvious: those lights all draw power. The design stage of any product must include a careful evaluation of the power consumption of each sub-assembly to achieve best possible performance in each area - but we are still ultimately dependant on the consumers' decisions.

Power consumption is also directly linked to the heat generated by the electronics: reducing power therefore reduces the heat, which needs to be removed from the box, and so maximizes the reliability of the electronic components. This gives the entire device a longer life, as well as reducing disposal and landfill issues.

A major design goal for Connect is the elimination of fans in its access products. This can be achieved by optimizing power consumption together with the use of a good physical design to remove heat through natural air flows. As the fans are electrically powered, removing them reduces power consumption still further. Elimination of fans is also popular with customers who prefer not to hear the sound of a fan, however quiet.

Reduced product weight and volume

Reducing the volume and weight of the product contributes highly to minimizing the environmental impact of three phases: Manufacturing, Distribution and End of Life.

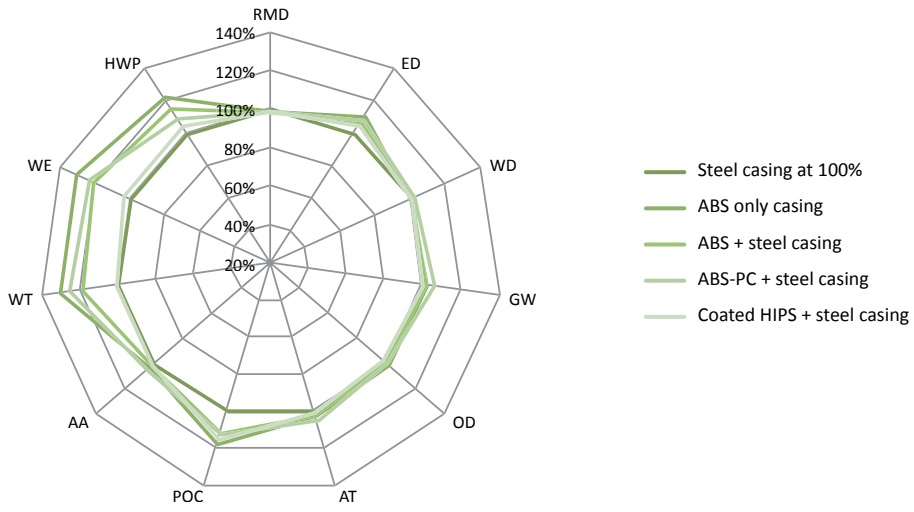
As far as the Manufacturing phase is concerned, this means that we need to build a more compact electronic product by reducing the number of electronic cards, use PWBs (Printed Wiring Boards or electronic cards) with more layers, use smaller Surface Mounted Devices (SMDs), more integrated chip sets, external power supplies and so on. Reducing electronic card size also permits the casing material to be reduced, as well as the packaging and the freight overheads by simultaneously increasing the number of products loaded per pallet.

Select plastic material with less environmental impacts

STB's casing is made with various material types: steel only, steel and plastic, plastic only. The graph below demonstrates that if a steel only casing has the best environmental performance - but limited possibilities in terms of aesthetic design - a mixed solution associating steel for shielding and mechanical hardness and plastic for external appearance may be a good compromise between the aesthetic and environmental impacts.

Moreover, this graph shows that the differences are even more significant regarding HWP (Hazardous Waste Production), WE (Water Eutrophication), WT (Water Toxicity) and POC (Photo Chemical Ozone).

FIGURE 3: STB WITH VARIOUS CASING ALTERNATIVE MANUFACTURING PHASE COMPARISON



Reducing Power Consumption through the Power Supply

The power supply type obviously has an impact on power consumption performance via its energy efficiency levels in various use and standby modes.

The graph (Figure x4) shows an LCA phase impact ratio of an EPS with high efficiency (83%). This graph demonstrates that the loss of power supply (17%) brings 90% of nine out of 11 impact indicators during the use phase.

In set-top boxes, for example, the power supply is developed as an integral part of the system design and so it is defined to respond appropriately to the specific needs of the device. This involves not just delivering the right voltages at the right places, but also interacting with the rest of the electronics in the device.

Power supply efficiency is maximized when the powering range is minimized. By ensuring that the electronics require the smallest number of different voltages and current changes, the power supply can be made simpler and more efficient.

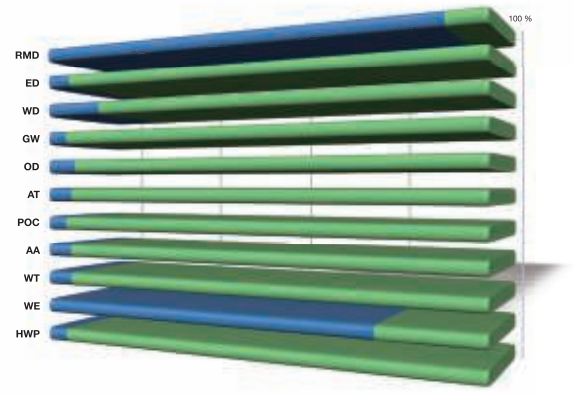
The power supply also has an impact on performance. For example, rapid start-up of the device calls for each part of the system to be turned on as quickly as possible. However, if the power supply is rated only for the steady state of the device, then it may not have sufficient headroom to support the start-up of multiple components simultaneously, forcing a longer start-up sequence. In an energy-efficient STB, for example, it might be necessary to start the disk drive and wait until it is up to speed before starting the tuners - at the expense though of the end-user's expectations of instant-on behavior.

In addition, a very low power standby mode demands a power supply with a higher energy efficiency below 1 watt in order to leave some power for the standby mode itself. For example a 50% energy efficiency at 1Watt on the AC side means that the standby mode should be implemented with only 0.5W on the DC side.

Another area of interest for Connect's engineers involves adding circuitry that can improve the power factor control of the power grid, i.e. the efficiency of the power coming into homes for all power usage. Millions of set-top boxes that can individually improve the power factor even a little can have a significant total impact on lowering the demand on an electricity supplier. Improved power factors allow home owners to use power more efficiently in all of their appliances.

FIGURE 4: EXTERNAL POWER SUPPLY IMPACT INDICATORS

Indicator	Manufacturing	Distribution	Use	End of life
RMD	92,20 %	0,00 %	7,80 %	0,00 %
ED	5,70 %	0,00 %	94,30 %	0,00 %
WD	14,00 %	0,00 %	86,00 %	0,00 %
GW	4,80 %	0,00 %	95,20 %	0,00 %
OD	7,30 %	0,00 %	92,70 %	0,00 %
AT	6,30 %	0,00 %	93,70 %	0,00 %
POC	4,80 %	0,00 %	95,20 %	0,00 %
AA	6,20 %	0,00 %	93,80 %	0,00 %
WT	6,30 %	0,00 %	93,70 %	0,00 %
WE	78,90 %	0,00 %	21,10 %	0,00 %
HWP	4,80 %	0,00 %	95,20 %	0,00 %



Other approaches being followed to reduce the environmental impact of devices

Even if one of the primary focuses of the design stage is to achieve the best energy performance, other environmental considerations come into play, including:
- The use of recyclable material: currently, environmental impact benefits are not given to a product with a high recycling ratio, but to a product which uses recycled material.
- The forecast of the product's end of life: product dismantling, production of recycling waste material and incineration material.

As part of its commitment to be environmentally-conscious, Connect is working to reduce all environmental impacts. This implicitly means that the manufacturing stage processes (Green Manufacturing) must allow the Connect Division to quantify the resources used and the waste released in order to adopt a truly cradle-to-grave environmental philosophy for its products.

LIFE CYCLE ASSESSMENT: THE DISTRIBUTION STAGE

Connect's customers can be found on every continent: its development teams are in the United States, Europe, and Asia, while suppliers and sub-contractors, who can demonstrate that they meet Technicolor's guidelines, are located around the globe. There is great potential here for achieving positive environmental change by sharing knowledge, methodologies and tools across this broad spread of stakeholders.

Connect reduces its environmental impact during the distribution stage by limiting its use of freight and by using environmentally-friendly packaging.

Limiting the freight of goods to ensure more environmentally - friendly delivery processes

The biggest environmental impact here comes from bringing components together for their final assembly and from delivering the finished devices to the customer. Whenever possible, final assembly is performed close to the point of delivery to the customer. Sub-assemblies, such as printed circuit boards, can be shipped in much greater densities than they are when combined into finished devices, which necessarily have empty space designed into them to allow for ventilation. In addition, wherever practical, production schedules are planned so that sea freight rather than air freight is used, as large ocean-going container ships have lower carbon emissions per-kilo than an aircraft.

Recent calculations of the corrected CO_2 equivalency values for various methods of transportation suggest that an ocean-going freighter creates the equivalent of 4.3 grams of CO_2 per-ton kilometer and long-distance rail 3.7 grams of CO_2, while a large truck produces 31 grams of CO_2 and intercontinental airfreight no less than 456 grams per-ton kilometer.

Protecting the environment through environmentally-friendly Packaging

Consumers are, of course, entitled to expect that their new device arrives in perfect condition, so it is essential to provide solid and protective packaging for the last stage of delivery to the home. However, that does not mean that environmental considerations should be forgotten.

Connect's goal is to use recycled materials for all packaging board with expanded polystyrene foam moldings being eliminated wherever possible. Recommendations, information and labeling about packaging recycling are clearly indicated for the end-user's attention.

With the agreement of the customer, paper documentation within the box is minimized when possible, for example ensuring that instruction booklets are precisely tailored to the target market, rather than using standardized, multilingual books which inevitably use much more paper. For products where Internet access is a prerequisite, only quick user guides are included which refer to web links where more detailed electronic user manuals can be accessed. In telephony access devices and set-top boxes, there are relatively few opportunities to use on-line or on-screen documentation but, where practical, this can save further physical materials and shipping weight.

The packages themselves are carefully sized to ensure that, while providing adequate protection for the product, they are as small as possible and can be stacked perfectly to fit the dimensions of standard pallets and containers.

LIFE CYCLE ASSESSMENT: THE USE STAGE

As previously demonstrated in Figure 1.1, as the PVR STB or a home gateway is expected to run 24 hours a day for five years (functional unit). The actual use phase will eventually have the largest environmental impact. Decreasing energy consumption should therefore be an important focus for ecodesign and bring major environmental benefits to any product's carbon footprint. The calculation results for the environmental impact of a product during its use life therefore depend on the following parameters:
- Product life duration
- Duty-cycle model of the device e.g. for a STB, the selected model is based on the "CoCv8 for STB" document, which defines the different use-mode typesin relation to its capabilities, such as SD/HD decoding, PVR APD, multi tuners, etc....
- Electricity model: all environmental impacts of the use phase are linked to the local electricity production mode

Reducing the device's energy consumption is not only the result of a good electronic design, but may also be achieved very efficiently by introducing a power management function. This function will be responsible for powering down the different subsystems of the device when unused and/or reducing system clock frequencies in relation to changing processing needs.

Recent Connect's STB products are designed in order to use dynamic power management features that activate different subsystems depending on the use case.

However, full exploitation of this capability for behavior optimization is still limited by:
- the capabilities of the other product subsystems like the Conditional Access and the Interactive Engine
- the provision of advanced services like "Push VOD" or the ability to remotely schedule recording

The STB might need to regularly update its internal data, so demanding that it is always - or at least occasionally - connected to its network. In practice, the product's final behavior is defined by the service provider, depending of course on the requirement of the imposed technologies (CA and Interactive engine) and acceptable compromises on the provided services.

For example, a STB with an integrated hard disk for recording will normally have at least two tuners to allow the consumer to watch one channel and record another. Some operators require that in standby mode, at least one tuners is kept running in order to realize "maintenance activity" (download EPG and access control data), and/or provide "push" video services, while other operators might ask to keep neither active.

Similarly, for an xDSL gateway, the IP telephony function needs to be available all the time to make or receive a call, even if other services are shut down.

Implementing various low power standby modes

The Duty Cycle model of the CoCv8, specifies that a STB without APD is in standby mode 15 hours a day. This implicitly means that the easiest way to reduce the STB's environmental impact is to implement a very low power standby mode. But, as explained previously, some services such as Terminal Management, VoD, EPGs and software updates may require that the STB provides permanent network connectivity. As a result, passive standby is not suitable with some service requirements or would cause inconvenience for the end-users.

However, in some cases, the user may have the ability to choose a compromise between the availability of particular features and energy consumption through a power management menu. This also explains why standby modes have grown in complexity: they need to cover many various types of service implementation and different situations.

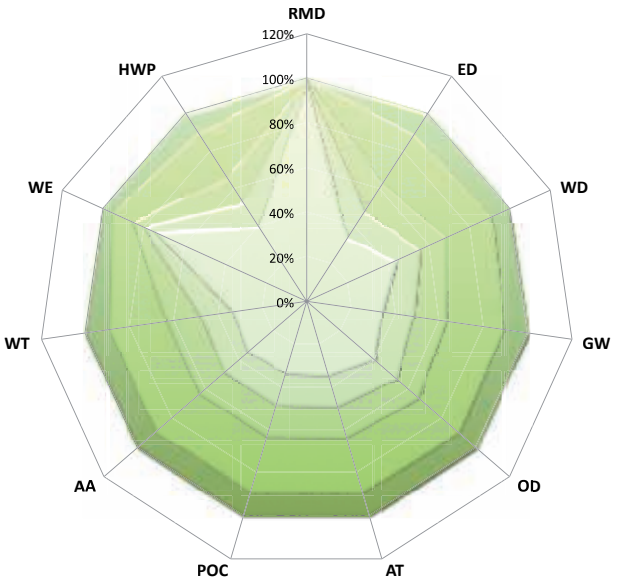
Connect's platforms are now designed to support a number of different working modes such as:

- Off-mode - disconnected.
- EuP Passive Standby providing only one - or several - reactivation functions
- Network-Standby, representing a kind of passive standby which in addition provides wake-on-LAN and/or wake-on-WAN capabilities. On top of that, network standby should always provide a minimum of connectivity, such as an Ethernet link or DSL access.
- Standby with return channel: this standby, specific to STBs equipped with a broadband return channel, is a standby mode where return channel functionality has to be still alive while the rest of the system can be shut down.
- Fast Standby providing a shortwake-up time.
- Active Standby, providing large functionalities, including WAN and LAN connectivity.
- Active mode.
- Etc.

The graph below compares the environmental impact of APD (Auto Power Down) and various other kinds of standby modes implemented on the same STB platform. This graph demonstrates the important environmental benefits of using very low power standby:a passive standby with APD provides a reduction of 60% on nine indicators out of 11, including the global warming carbon footprint indicator.

FIGURE 5: ENVIRONMENTAL IMPACT OF APD AND VARIOUS STANDBY MODES

- PVR Cable STB with active standby at 100%
- PVR Cable STB with 2,5'HD and active standby
- PVR Cable STB with APD and active standby
- PVR Cable STB with APD and fast RC standby
- PVR Cable STB with APD and fast standby
- PVR Cable STB with APD and passive standby



Regarding XDSL Gateways, we are working to develop an out-of-the-box gateway by implementing dynamic power-down of functions that are not in use, such as the auto powering down of the Ethernet ports of products based on the newest chipsets. In the next software releases, planned for mid-2010, we will have a time-based ability to schedule the automatic switch off of certain functions through the GUI or the ECO button.

The problems however should not be limited to the devices' standby capabilities: Some Technicolor VDSL2 and ASDL2+ home gateways are support the L2 state which is a low bit rate mode which is compatible with VoIP services. This L2 state as well as the L3 (sleep mode) provides some reductions in power consumption on the DSLAM side (but not on gateway side) and a fast reestablishment of the full rate connection. Until now, the DSLAM operators and vendors do not support-or make available - L2 and L3 states.

It usually takes a standard xDSL link several seconds to reestablish a connection. As both operators and end-users want a fast connection time of ideally below three seconds, this may explain why it is tempting to use these expectations as a reason to maintain a full broadband connection all the time. A more energy-conscious solution will be to support L2 and/or L3 states on the DSLAM, as well as on the home gateway.

Finally, specifying the exact nature of the various standby or off-modes required is a vital topic for debate when creating a tailored design for a customer such as a service provider or an operator.

Implementing power management

Power management functions on a STB involve more than just implementing one or several standby modes and these are much more complex than the technologies commonly used in the computer industry.

The key principle behind effective power management is to be able to activate functions only when needed, thus significantly reducing the power consumption of the device. Power management requests can involve a full redesign of the whole system, including the software which drives the functionality of each device.

As an example, a VoIP phone in low power mode will only need a reactivation function driven either by network signaling or by a user's action.

This could be achieved by switching to a lower speed connection and shutting down the DSP used for voice coding or decoding.

FEMTOCELL GATEWAYS REDUCE POWER CONSUMPTION BY 50%

Another example of Connect's environmental stewardship is the TG870 home gateway with integrated femtocell (home access for 3G cellular phones). Incorporating the femtocell into the home gateway rather than into a standalone device in itself reduces energy consumption, but the design of the TG870 also incorporates an eco-mode which cuts average power consumption by half, significantly reducing its environmental impact still further.

It should be noted that gateways, STBs or other devices are just one part of the whole energy equation: the service or network provider also has an equal role to play. There are tradeoffs to be made between functionality, performance, and energy consumption. The service provider must contribute to the end users' understanding of this balance and allow them to come to an informed decision. The best possible performance can only be achieved through collaborative end-user education initiatives from both operators and Technicolor's Connect Division.

While environmental considerations may be on the consumer's decision list, top priority will always be given to whether the unit performs well and is reliable. Needing to replace a unit after only a few years to meet changing requirements is clearly bad environmental practice - as well as being commercially unsound. However, a too long product life is also not good for the planet, because old products will have a significantly greater power consumption and global warming impact compared to new products which may have the benefit of the latest more efficient, low power technologies. It is therefore necessary to find a mutual consensus on product life duration.

Good practice involves developing products which not only meet today's requirements but are also capable of software upgrades in the future to deliver new functionalities or for improved maintenance purposes such as bug fixing. Whenever possible, these upgrades should be achievable by using software downloads, thus eliminating the need for an engineer to visit the consumer's premises, or for the consumer to take the device to a service center.

INCORPORATING INTELLIGENT CONTROL OF POWER CONSUMPTION AND INCLUDING DEEP SLEEP MODE OF LESS THAN 1W

The latest generation of HD interactive cable PVRs incorporate advanced power management techniques to allow them to exceed the requirements of the new European legislation on standby modes, as well as the expected requirements for total energy consumption, by defining a number of different operational steps through which power consumption can be optimized. Moreover, the product is available in a much smaller footprint box, leading to reduced transportation and material usage impacts.

In particular, the DCI804 forms part of a pilot project within Connect to study and reduce the environmental impact of products over eleven key criteria of pollution throughout the entire product lifecycle by establishing a comprehensive ecological profile for the product.

Connect works with its customers in the broadcast and telecommunications industries to develop access products which are capable of taking software upgrades that can help to extend the lifecycle of its products. This does usually means specifying for the product some greater capacities or capabilities than those which are immediately needed, but this approach also provides an insurance policy that means that the product will be able to continue delivering satisfaction to the consumer for up to six or even ten years.

LIFE CYCLE ASSESSMENT: THE DISPOSAL STAGE

At the end of their useful life, products also need to be disposed of.

As the WEEE implies, all manufacturers must find solutions to collect and treat the products that they put onto the market. Technicolor's Connect Division works with third-party companies through collective compliance schemes in each marketplace to manage the safe disposal of old equipment as required under this legislation.

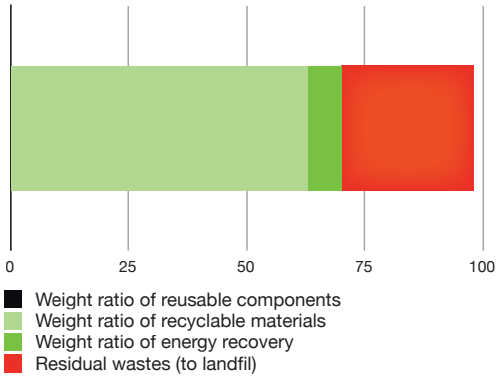
The LCA tool simulates the end-of-life treatment steps and enables the potential recycling and recoverables rate for the equipment to be estimated. The graph below (Figure 6) describes a STB potential impacts at the end of its life.

As an integral part of its commitment to environmental responsibility, Connect designs product for easier disassembly and provides information to help recycling and disposal.

In addition, Connect aims to clearly indicate those raw materials used in its products .

In every market, Connect encourages its customers to provide comprehensive information to their consumers, and makes environmentally aware decisions when the time comes to dispose of old equipment, ensuring that as much as possible is recycled and any harmful elements are not committed to landfill.

FIGURE 6: CALCULATION OF THE RECYCLING RATIO FOR A STB (EXCLUDING THE PACKAGING)



CONCLUSION

Consumers and customers both demand high-performance electronics devices such as STBs, gateways and broadband access terminals. The challenge now for manufacturers is to fully control the environmental impact of their products throughout the entire lifecycle from conception to final disposal.

Technicolor's Connect Division meets this challenge by:
- A direct involvement in environmental regulation and voluntary initiative bodies
- Defining and communicating clear environmental policy and objectives
- Deploying ecodesign methodologies and LCA tools, that allows Connect:
  - To be able to take into account specific customer environmental requirements
  - To control all products' environmental impacts and not restrict ecodesign improvements solely to reducing power consumption
- Proposing products with ecodesign alternatives that meet both a customer's environmental objectives as well as their infrastructure capabilities, such as various power management features, various standby modes, various casing materials, etc.
- Communicating to customers and end-users about each product's environmental performance through PEP

Today, even if power consumption reduction still represents a significant part of a product's ecodesign, it is not all of it. True product ecodesign means having the ability to quantify through LCA tools the environmental impact of the product from the cradle to the grave. This environmental impact quantification is the essential condition for a real ecodesign process and should be based on LCA comparisons of alternative designs that cover mechanical, electronic, software and other functionalities. With an LCA tool able to quantify all the environmental product impacts - and with PEP to inform customers as well - ecodesign becomes a comprehensive, environmentally efficient design methodology: all actors, manufacturers, service providers and end-users can become responsible for their choices in terms of product manufacturing, product selection and product use.

For more information or additional results on LCA measurements for other products, please contact us at:
thinkgreen.connect@technicolor.com

GLOSSARY

PEP (Product Environmental Profile):	A Product Environmental Profile is a document that describes the environmental characteristics of new or modified products. A Technicolor PEP document consists of the following sections: product identification and description, product energy information, regulations and standards compliance, emissions information, product environmental impact indicators (a total of 11 indicators).
RMD (Raw Material Depletion):	This indicator calculates the depletion of natural resources, taking into account the size of the reserve for that resource in the ground and the consumption rate of today's economy. It is expressed in fraction of reserve disappearing per year Y-1 (because the consumption rate is expressed as a quantity per year).
ED (Energy Depletion):	This indicator shows the consumption (or use) of energy, either derived of the combustion of fuels (fossil or not) or from other sources (hydroelectricity, tidal, solar, wind). Nuclear electricity is included in energy from uranium fuel. The indicator also considers the latent energy in materials which is produced during the combustion of the material, typically at the end of its life. It is expressed in MJ.
WD (Water Depletion):	This indicator calculates the consumption of water, i.e. the sum of any kind of water source or quality (drinkable, industrial ...). It is expressed in dm3.
GWP (Global Warming Potential):	This indicator calculates the contribution to the global warming of atmosphere through the release of specific gases. It is expressed in grams of CO_2 - as if all gases were CO_2 – by using their equivalent in warming potential.
OD (Ozone Depletion):	This indicator calculates the contribution to the depletion of the stratospheric ozone layer made by releasing specific gases. It is expressed in grams of CFC-11 - as if all gases were CFC-11 – by using this equivalent in their depletion potential.
AT (Air Toxicity):	This indicator calculates the air toxicity in a human environment, taking into account the usually accepted concentrations tolerated for several gases and the quantities released. It gives a volume of « unhealthy air ». It is expressed in m3.
POC (Photochemical Ozone Creation):	This indicator calculates the potential creation of tropospheric ozone («smog») made by releasing specific gases which will become oxidants in low atmosphere under the action of solar radiation. It is expressed in grams of ethylene (C_2H_4) - as if all substances were C_2H_4 - using their equivalent potential.
AA (Air Acidification):	This indicator represents the air acidification caused by gases released into atmosphere. It is expressed in grams of H^+ - as if all gases were H^+ - using its equivalent in their acidification potential.
WE (Water Eutrophication):	This indicator calculates the water eutrophication (enrichment in nutritive elements) of lakes and marine waters caused by releasing specific substances in effluent. It is expressed in grams of PO_4^{3-} - as if all substances were PO_4^{3-} - using its equivalent in their nitrification potential.
WT (Water Toxicity):	This indicator calculates water toxicity by taking into consideration the usually accepted concentrations tolerated for several substances and the quantity released. It is expressed as a volume of « unhealthy water ». It is expressed in dm3.
HWP (Hazardous Waste Production):	This indicator calculates the quantity of hazardous waste produced for a given product. It is the sum of the flows of LCA inventory which correspond to hazardous waste. It is expressed in kg.
Functional Unit:	This is a measure of the function of the studied analysis and provides a reference by which the inputs and outputs are related, so enabling clear comparisons to be made. For example, the functional unit for a home gateway STB may be defined as "Provide high speed connection to Internet 5,4 hours a day during 4,5 years". A comparison of the environmental impact of two different GTWs with the same functional unit is therefore possible.
Duty Life Cycle:	This is the proportion of time during which a component, device, or system is operated.
Auto Power Down:	This is the capability for a product to automatically switch from the On state to the Standby state after a period of time without user input.

ABBREVIATION LIST

AA: Air Acidification

APD: Auto Power Down

CPE: Customer Premises Equipment

DECT: Digital Enhanced Cordless Telecommunications

DSLAM: Digital Subscriber Line Access Multiplexer

ED: Energy Depletion

EH&S: Environment, Health and Safety

EPG: Electronic Program Guide

EPS: Electric Power Supply

EuP: Energy Using Products

GW: Global Warming

HWP: Hazardous Waste Production

LAN: Local Area network

LCA: Life Cycle Assessment

NSP: Network Service Provider

NW: Network

OD: Ozone Depletion

PEP: Product Environmental Profile

POC: Photochemical Ozone Creation

PVR STB: Personal Video Recorder set-top box

REACH: Registration, Evaluation, Authorization and Restriction of Chemical Substances

RMD: Resource material depletion

ROHS: Restriction of Hazardous Substances

STB: Set-top box

SW: Software

VoIP: Voice-over-IP

WD: Water Depletion

WE: Water Eutrophication

WEEE: Waste Electrical and Electronic Equipment

WT: Water Toxicity

WAN: Wide Area Network

ABOUT TECHNICOLOR

With more than 95 years of experience in entertainment innovation, Technicolor serves an international base of entertainment, software, and gaming customers. The company is a leading provider of production, postproduction, and distribution services to content creators and distributors. Technicolor is one of the world's largest film processors; the largest independent manufacturer and distributor of DVDs (including Blu-ray Disc); and a leading global supplier of set-top boxes and gateways. The company also operates an Intellectual Property and Licensing business unit. For more information: www.technicolor.com

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WP-001-v01-1001