DEESD
IST-2000-28606
Digital Europe: ebusiness and sustainable development

The environmental and social impacts of digital music

A case study with EMI

Final Report, July 2003

By Volker Türk, Vidhya Alakeson,
Michael Kuhndt and Michael Ritthoff

This report constitutes part of Deliverable 12 (D12) of the project DEESD – Digital Europe: e-business and sustainable development

Project funded by the European Community under the "Information Society Technology" Programme

(1998-2002)

Table of Contents

List of Figures

List of Tables

List of Boxes

1. Reader's Guide

The following report presents the findings and recommendations of the EMI case study undertaken as part of the Digital Europe project.

Chapter 2 sets out the background to the case study; chapter 3 investigates the environmental impacts of digital music; and chapter 4 highlights the social impacts of digital music. Chapter 5 outlines future scenarios for the sector and chapter 6 draws recommendations for business and government.

The following table outlines the content of chapters 3 and 4 in more detail.

Table 1-1: The structure of the report.

Chapter	Description of content
3.1	Introduces the research objectives and research methodology.
3.2	Outlines the three scenarios explored in the environmental investigation.
3.3	Presents the material intensity calculations for the three scenarios.
3.4	Summarises the results for each scenario.
3.5	Discusses the findings in chapter 3.3 and 3.4 and draws conclusions.
4.1	Introduces the research objectives and research methodology for the social part of the case study.
4.2	Gives an overview of the social role of music.
4.4 – 4.8	Discusses risks and opportunities created by digital music for the social role of music.
4.9	Draws conclusions for the music industry based on discussion in 4.4-4.8
5	Discusses the environmental and social impacts of future trends
6	Puts forward recommendations for EMI, the music industry and government

2. Background

2.1 Digital Europe: Ebusiness and Sustainable Development

Digital Europe: Ebusiness and Sustainable Development (henceforth referred to as *Digital Europe*) is the first comprehensive analysis of the relationship between ebusiness and sustainable development in Europe. The project is rooted in a unique partnership between three leading sustainable development research organisations, leading companies with an interest in ebusiness, and regional bodies from across the EU. It draws on the knowledge and expertise of a range of member state and EU policymakers. In doing so, *Digital Europe* focuses on the current realities of ebusiness in Europe in order to identify opportunities for ebusiness to contribute more effectively to sustainable development.

2.2 The EMI Group

The EMI Group is the world's third largest record company and the world's largest music publishing company. EMI Recorded Music has a roster of over 1,000 artists; EMI Music Publishing owns or administers over one million copyrights. These two divisions together employ approx. 9000 people in 46 countries and more than 200 business locations worldwide. EMI owns or has a share in 5 manufacturing plants worldwide, which produce around 500 million units of audio per year; around 90 per cent of this output is CDs. One of the biggest production facilities with an annual production of over 200 million CDs for the European market is EMI Compact Disc (Holland) in Uden. Information on the production process for CDs is based almost entirely on processes used at the plant in Uden.

2.3 The EMI Case Study

The case study with EMI will compare the environmental impact of digital music files downloaded via the internet with more traditional ways of delivering music to consumers. In total, three different scenarios will be explored. In each scenario, the digital component of the product life-cycle is different.

1. "Physical retailing" scenario:
   The entire life cycle is rooted in the material world. A CD is produced, shipped and finally purchased by the consumer in a local CD store.

2. "Online shopping" scenario:
   The production part stays the same as in the first scenario, but the distribution part of the life cycle is different. The CD is ordered via an online shop and delivered by parcel or postal service to the consumer.

3. "Digital delivery" scenario:
   In the last scenario the entire life cycle is more or less detached from the material world. The consumer downloads the respective song(s) as files via the internet, instead of purchasing a physical product (CD). All customer/retailer interactions and transactions take place over the internet. However, depending on consumer habits, the files may be burnt onto a blank CD (CD-R), recreating the physical product.

Secondly, the case study will scope out risks and opportunities arising from the digital production and distribution of music for the role of music in society, focusing on access to music, opportunities for creativity, the promotion of diversity and participation in music.

3. The Environmental Dimension of Digital Music

3.1 Objectives and Methodology

Chapter 3.1 introduces the objectives and the methodology that have been used to assess the environmental impacts of digital music.

3.1.1 Objectives

By assessing the environmental impacts of digital music, this case study feeds into one of Digital Europe's overall objectives to assess the environmental impacts of ebusiness. The Wuppertal Institute, in close cooperation with EMI, have set out the following specific objectives for the case study:

- To assess the life-cycle wide environmental impact of digital music with respect to material flows and transport efficiency, by applying the MIPS concept (see 3.1.2) ;
- To create different scenarios in order to assess the potential environmental impacts of different channels for the distribution of music over the next 2 to 5 years[1],
- To identify and highlight possible ways of reducing the environmental impacts of the music industry based on analysis of product life-cycles;
- On a more strategic level, to highlight the potential of different product or service distribution strategies to increase resource efficiency; and
- To put forward recommendations for industry and policy-makers as to how new digital products and services could contribute to a more sustainable future.

3.1.2 Underlying Methodology – the MIPS Concept

There is growing agreement among policy makers, academics, business and non-governmental organisations that total resource productivity[2] needs to be increased by a Factor of 2 globally, a Factor of 10 in industrialised countries within one generation[3], and by a Factor of 4 within the next decade[4] in order to move us towards a sustainable economy. To achieve this, we need to optimise resource use at every level of society: at national (macro), sectoral and regional (meso) levels, as well as at the level of the individual firm and household (micro level).

---

[1] Originally it was intended to look at a time-frame of 10 to 15 years. However, within the music sector, new channels, business models etc. are springing up all the time, so that the time frame has been adjusted in accordance with the project partners.

[2] Resource productivity: Factor of how much use can be made from a certain amount of resources (nature). Resource productivity is the inverse of the material intensity. For further information see the end of this section.

[3] The Factor Ten Club. 1997: The Carnoules Declaration- Statement to Government and Business Leaders; Wuppertal Institute for Climate, Environment and Energy; Wuppertal, Germany.

[4] Weizsäcker, E., Lovins A. B., Hunter Lovins, L. 1997: Factor Four Doubling Wealth - Halving Resource Use, London: Earthscan Publications Ltd.

Factors 4/10 refer to total material flows (including material flows for energy production) within the economy and have been set as long-term targets by some countries[5]. The contributions of individual industries, processes and product life cycles to these national resource productivity targets will depend on their relative contribution to resource consumption and their potential to make improvements.

Leading environmental thinker, Schmidt-Bleek has developed a methodology called MIPS to calculate the **M**aterial **I**nput **P**er **S**ervice unit (MIPS)[6] which he proposes as the unit to measure Factor 4/10 improvements in resource efficiency. MIPS measures the direct material input (MI) taking into consideration hidden material flows, i.e. the total mass of material associated with an item of consumption in the course of its life cycle.[7] There are five main categories of material input:

- Abiotic raw materials, for example minerals, fossil fuels, excavation residues;
- Biotic raw materials, for example animal and plant biomass from farmed and non farmed areas;
- Soil movements (in agriculture and forestry), for example soil cultivation, erosion;
- Water, for example surface water, ground water;
- Air (compounds), for example combustion, chemical synthesis.

Example

A gold ring of about 10 g carries an invisible ecological backpack of 10 x 540,000 g, or more than 5 tonnes.

"Soil movements" and "air compounds" are considered to be relatively unimportant for the EMI case study and are not displayed in the results.The total MI for a product consists of the materials used directly or indirectly during the life cycle. The "ecological rucksack" is the part of MI which does not enter the end product itself. Rucksack factors for non-renewable materials range from 1.2 for natural gas, 7 for steel, 8 for PVC, 85 for aluminium, 140 for nickel, 500 for copper, up to 540 000 for gold.[8] With the help of MI factors, the rucksacks of finished products can be calculated. It is possible to distinguish the MI of different phases of the life cycle: production, usage, repair, recycling or disposal. Thus different phases of a product's life-cycle can be viewed in relation to the overall material intensity in order to

---

5 „Ecocycle" – Commission from the Swedish Government is driving for a Factor 10 within the next 25-50 years (Kretsloppsdelegationens Rapport 1997/13: Hallbrat Sa Klart – en Kretsloppstrategi", Stockholm), The Netherlands formulated a Factor 4 goal in their national environmental plan in 1996 (Ministry of Housing, Spatial Planing and the Environment. 1996: National Environmental Policy Plan, The Netherlands), Austria wrote a factor 10 goal into their national environmental plan in 1995. (Austrian Government. 1995: National Environmental Action Plan, Vienna, Austria.) The German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety suggested a 2,5-fold increase in raw material productivity by 2020 compared to 1993 and a 2-fold increase in energy productivity by 2020 compared to 1990. (The German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety. 1998: Sustainable Development in Germany - Draft Programme for Priority Areas in Environmental Policy, Bonn, Germany.)

6 Schmidt-Bleek, F. (1993). *MIPS- Revisited*. Fresenius Environmental Bulletin, 2, 407-412.

7 Schmidt-Bleek F., 1994, "How much environment does the human need?" MIPS - the indicator for ecological societies (Wieviel Umwelt braucht der Mensch? "MIPS - Das Mass für ökologisches Wirtschaften") Boston/Basel/Berlin: Birkhäuser Verlag.

8 Schmidt-Bleek, F. 2000, "Factor 10 Manifesto", Factor 10 Institute, La Rabassière, F-83660 Carnoules, France, January 2000.

identify the areas of greatest potential for improving resource productivity. This can then inform an effective resource efficiency or dematerialisation strategy which will maximise the value added per unit of resource input. MI calculations are based on the end user service (S) provided by the product in question.

$$\frac{\text{Resource consumption (Material intensity or input)}}{\text{Service provided (Service unit)}}$$

MIPS seeks to provide material flow information with the aim of "increasing resource productivity". The inverse of material intensity (MIPS) is the material or resource productivity, i.e. how much use can be made from a certain amount of resource (nature). It is generally true that a reduction of inputs or an increase in the number of service units (efficiency strategies) lead to an increase in resource productivity. In both cases, the amount of resource consumed per unit of service is reduced**.**

3.1.3 Service Unit

Section 3.1.2 set out the basic function of the service unit. The service unit is key to any MIPs calculation. Definition of the service unit is an important step in the analysis as it determines data requirements and the relevance of the results obtained. When defining the service unit it is important to make sure that:

a. The unit allows comparison of many different product or service alternatives. Hence it should be phrased in a generic way;

b. The unit reflects all important usage aspects of the product/service;

c. The measure of the unit is understandable and applicable for a broad audience.

For this particular case study, different service units are conceivable, for example:

- Comparison of x megabytes of music
  Not a preferred choice, since it conflicts with b) and c). The basic service the customer is interested in is enjoying music and not in the provision of digitised music.
- Comparison based on an individual song.
  Conflicts with b). The comparison is easier to understand for a broad audience when it relates to "commonly known units", which in case of music is a CD. Customers tend to purchase albums or singles rather than individual song files.

The most obvious service unit is one CD or more precisely the music stored on one CD. The average playing time of a CD at EMI is 56 minutes or 465.50 MB of data in total[9]. This equates to 14 songs of 4 minutes each. However, music provided online is in most cases downloaded as single files (tracks) and not as an entire album[10]. Therefore a physical CD should be compared with the provision of 56 minutes of music via the internet to the consumer. Consequently the service unit is defined as:

---

[9] EMI, 05 March 2002. Site visit of WI staff at EMI's production site in Uden, the Netherlands, including a meeting with key EMI staff (Kate Dunning, Jeanine van der Sterren, Senta Schiffeleers). It was stated that the maximum storage capacity of a CD are 640 MB or 77 minutes of music.

[10] EMI estimated that something like 99 per cent of consumers of digital music download single tracks (EMI, 22 March 2002. Visit of WI staff at EMI headquarter in London, including a meeting with representatives from OD2.). Subsequent market development indicates a shift towards album purchase.

Service unit: Provision of 56 minutes of music to the consumer

3.2 Setting the System Boundaries

This chapter describes the processes involved in each of the three scenarios described in 2.3 and outlines the system boundaries, i.e. identifying the parts of the life-cycle included within the scope of each scenario. An in-depth description of figures and data is presented in chapter 3.3.

3.2.1 Scoping

This study looks at different ways of distributing music. In doing so, it is assumed that it is ultimately the music that customers want to buy. A CD does offer additional “service units”, for example, the information provided in the booklet or the packaging graphics. However, including these service units would preclude effective comparison between digitally distributed music files and physical CDs since digital files would not be a direct substitute. Nevertheless, the resources required to produce the booklet are included, since it is not possible to buy a CD without it.

Figure 3-1 presents a generic and simplified outline of the different stages in the music distribution process which is valid for all three scenarios. Within the scope of the study are – where applicable - CD production, its warehousing or storage (shelves or server), purchase by the consumer, the required transportation and distribution (either physically or digitally) and final disposal.

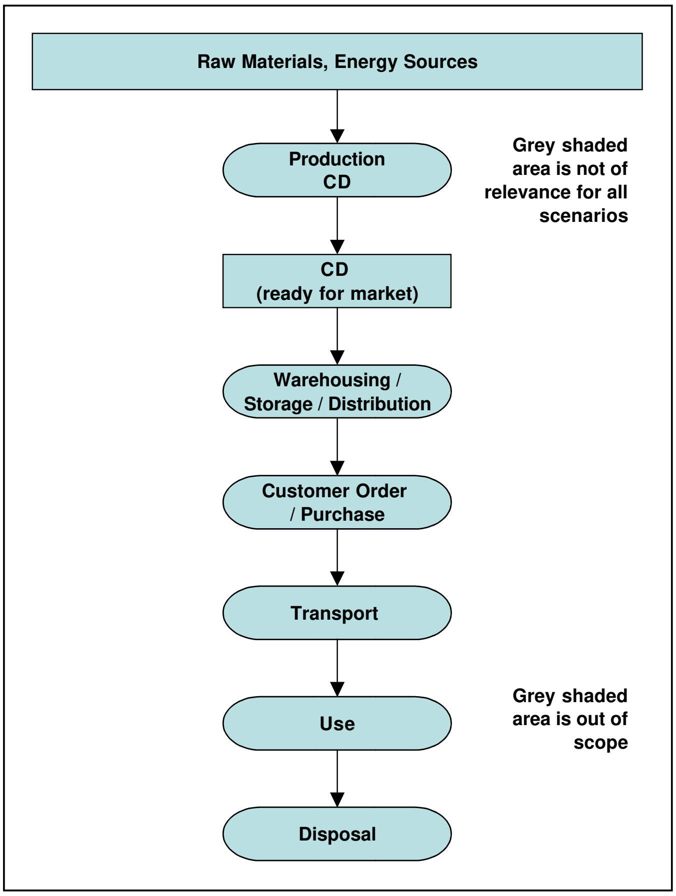

Figure 3-1: Generic process flowchart.

Most of the data gathered relating to CD production comes from EMI's production site in Uden (EMI Compact Disc (Holland) B.V.). The geographic scope of the study is Europe, since only five per cent of EMI's production in Uden is shipped beyond the European market[11].

To ensure comparability of results and focus, the following will be out of the scope of the study:

- Separate offices and administration buildings including office and IT infrastructure;
- In all scenarios, the music needs to be recorded and mixed in order to be distributed to the final consumer. This does not affect the final distribution channel (CD, download) and will therefore not be considered;
- The use phase of the music. The number of devices used to play songs is vast (high-end hi-fi systems, portable CD players, mp3 players, PCs etc) and consumer preferences unpredictable. Furthermore, a life cycle study of the environmental impact of compact discs states: "from the first global LCA it emerged that the usage phase [of CDs] causes very little environmental burden[12]"
- Materials or other factors (e.g. transportation) that contribute less than one per cent to total material intensity, calculated by applying material intensity factors.

Included within the scope are production, delivery/distribution, retail and the end-of-life phase. A detailed overview of each scenario is presented in chapters 3.2.2 to 3.2.4. When it comes to the technical storage of digital music, current state of the art in technology is assumed, meaning CD-Rs that provide storage for 700 MB[13][14].

3.2.2 Physical Retail Scenario

The distribution of music in physical form to retail outlets is still the dominant distribution channel for EMI, accounting for roughly 99 per cent of total volume in recorded music sales[15]. In general, this scenario encompasses the full range of processes outlined in figure 3-2, namely production, distribution, warehousing, retail, use and end-of-life. The production process is further subdivided into several sub-processes and pre-production processes, as highlighted in the following flowchart. The process steps where the use of Information and Communications Technology (ICT) is significant are marked with a grid shaped pattern. The parts of the process where the use of ICT is insignificant from an environmental perspective, such as in the production of a CD master and CDs themselves or in facilitating logistics, have not been highlighted.

---

[11] EMI, 05 March 2002.

[12] Krachtwerktuigen Consultancy. (1997). *Roundabout: Closure of the compact disc circle. Reduction of the environmental burden within the compact disc chain*. Interim report, 18 December 1997, p.2.

[13] Whatis?com. (2001). *CD-R.* [Online]. Available: http://searchStorage.techtarget.com/sDefinition/0,,sid5_gci508073,00.html [2002, July 15].

[14] Future mass storage media will have significant larger capacities. A current DVD holds 4.7 GB of information on one of its two sides, but they haven't reached the mass market in the area of music yet. With two layers on each of its two sides, it will hold up to 17 GB of data. Future but already foreseeable technologies such as blue laser technology will further increase the capacity by a factor of two to four.

[15] EMI, 05 March 2002.

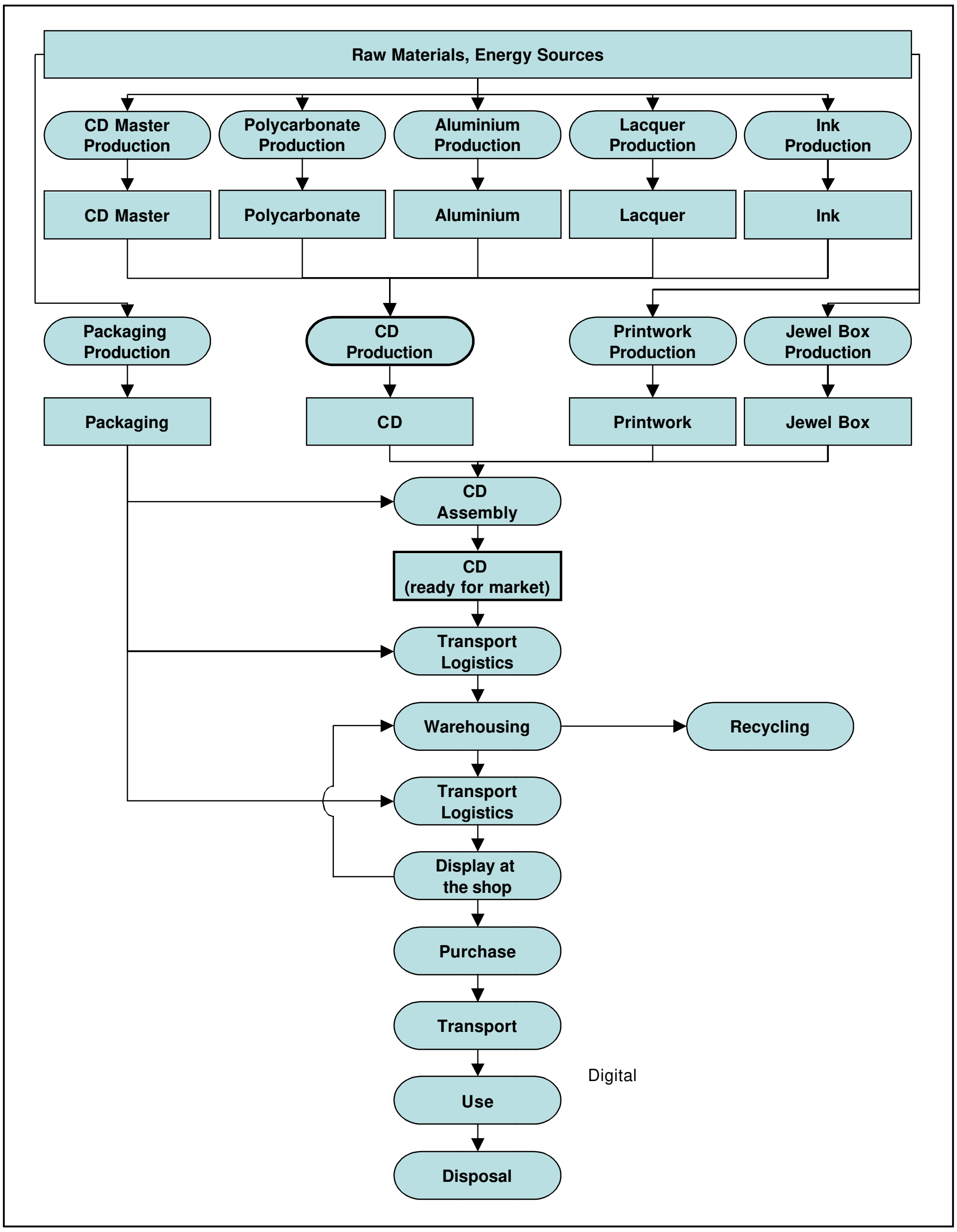

Figure 3-2: Process flowchart physical retail scenario.

The following is a short description of the processes included in the analysis:

The first step in CD production is the manufacturing of the stamper or CD Master for the injection moulding machine. Glass, nickel and a couple of other auxiliary materials are used in this process.

The actual production of the CD starts with polycarbonate (PC), which is then injection-moulded in the CD stamper. An aluminium layer is applied to the top in order to reflect the laser beam when the finished disc is played. A protective coating is then applied, for which UV hardened lacquer is used. All three steps are combined in a single machine, with a capacity of 25,000 CDs per day.

Once the disc is produced, the label is printed on one side, and the finished CD is put into the jewel box together with the booklet and inlay. The CDs, some of which are individually wrapped in plastic foil, are then packed into cardboard boxes holding, on average, 25 discs.

The packed goods are stored at the central distribution centre for Europe located next to the production site in Uden, awaiting transport to national distribution centres (NDCs). From there, CDs are transported to local hubs and then on to retailers. Having been stored at the retailer, CDs are purchased and transported home by the final customer. The infrastructure required to produce and store CDs is included in the scope of the analysis; the transport infrastructure, however, is excluded. At the end of its life-cycle, the CD may be disposed of in the municipal waste stream.

The Wuppertal Institute has an extensive database with material intensity data on various industrial (raw) materials and processes. This data proved to be useful as a basis for the analysis of the main raw materials in a CD - polycarbonate (PC), polystyrene (PS), polyethylene (PE), aluminium, lacquer and ink.

3.2.3 Online Shopping Scenario

The online shopping scenario acts as a bridge between the other two scenarios. The first part of this scenario is still very much tied to the traditional, materialised world. Thus the steps described in 3.2.2 up to and including transportation to the retail warehouse are relevant here. However, when it comes to interaction with the final customer, the internet plays an important part. The following flowchart outlines the steps in this scenario:

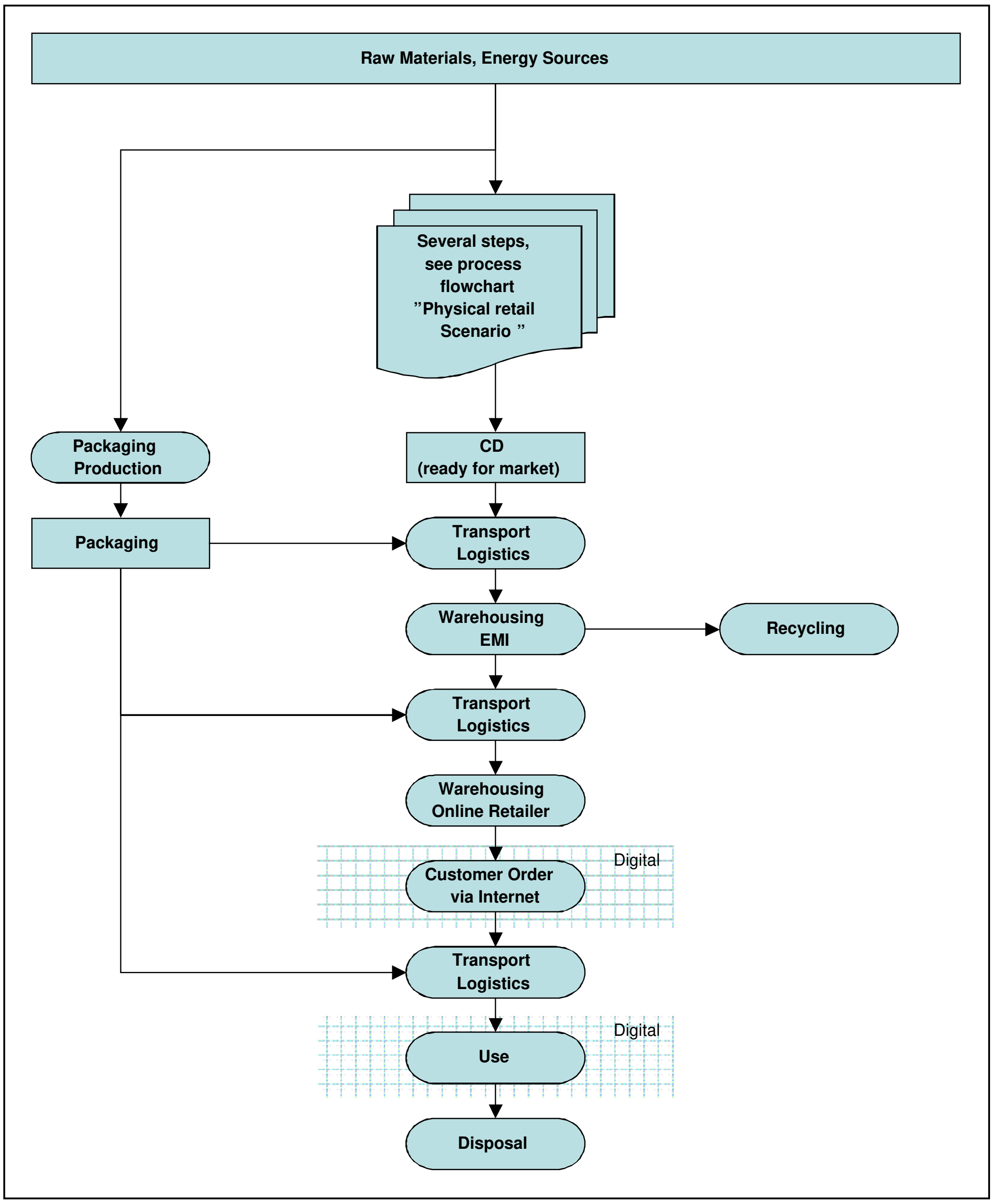

Figure 3-3: Process flowchart for the online shopping scenario.

Comparison of the physical and online flow charts shows similarities in the early phases; however in the online scenario CDs are transported for storage to online retail warehouses and displayed on the internet instead of in a shop. Consumers can access the internet site and order the CD online. It is then delivered by a parcel or postal service.

3.2.4 Digital Delivery Scenario

Depending on the underlying assumption, the digital delivery scenario can take place entirely in the digital world. This depends on whether or not the option of burning files on a CD (or storing them on other media) is taken into consideration. Based on current market share, this distribution channel is still rather insignificant. OD2, a UK-based music subscription platform provider, estimates it to be less than 0.5 per cent of the worldwide music market (March 2002). However, the potential seems to be quite significant, considering that some 4.5 billion tracks are downloaded illegally every month[16]. The flowchart below sketches out the processes involved in the digital delivery scenario:

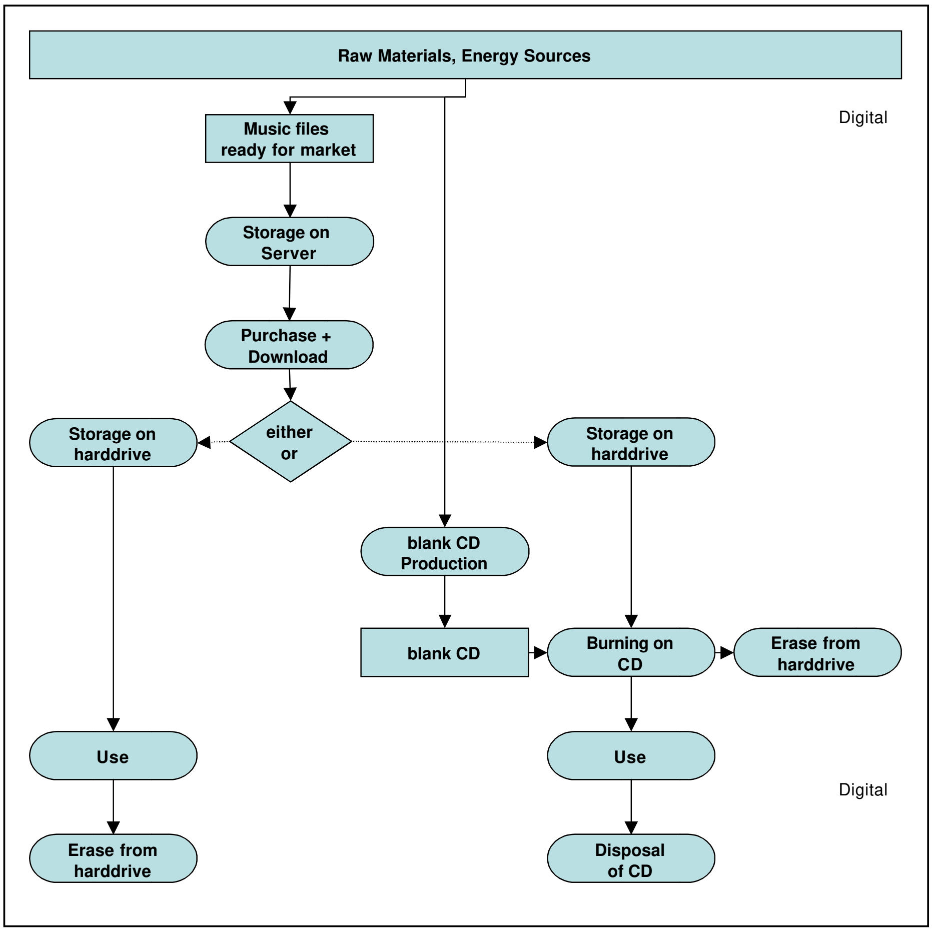

Figure 3-4: Process flowchart of the digital delivery scenario.

Music files in digital format are transferred into a downloadable and playable music format and stored on a server. From that server the final customer can download the file. Once the music files are downloaded via the internet, two storage options will be considered. The likelihood of one or the other depends to a large extent on the business models employed in the future. One option is that the file will only be stored on the hard disk of the PC or some other sort of storage device. Modern computers are equipped with hard disk capacities of (tens of) gigabytes, making the storage of a large number of songs possible.

However, a common habit is to store or compile digital music files on blank CDs (CD-Rs). The production of CD-Rs differs only slightly from that of pre-recorded CDs as described in 3.2.2. According to the Optical Storage Technology Association (OSTA)[17], CD-R manufacturing is similar to the injection moulding of pre-recorded CDs. As with a pre-recorded CD, a CD-R is packaged, distributed, stored in a shop and bought by the final consumer, before music files are burned onto it. CD-Rs are commonly sold in bundles of 10

---

[16] EMI, September 2002.

[17] Optical Storage Technology Association (OSTA). (2002). *CD-R and CD-RW Questions and Answers Manufacturing Process*. [Online]. Available: http://www.osta.org/technology/cdqa6.htm [2002, May 15].

or more discs. The report will analyse the digital delivery scenario with and without CD burning.

3.3 Data Inventory & Calculations

Chapter 3.3 provides an overview of the data used in the material intensity analysis and presents the results. An overview of the results is provided in chapter 3.4.

For each process step considered, the material intensity is expressed in kg of abiotic and biotic raw materials and water usage, in accordance with the underlying methodology as presented in chapter 3.1.2.

3.3.1 Physical Retailing Scenario

If not otherwise stated, data on the production and distribution of CDs relate to EMI's production site at Uden in the Netherlands.

3.3.1.1 Production site

In the case of "light products" such as CDs, infrastructure can contribute a considerable share of the overall material intensity of the product. By dividing the aggregated material intensity of buildings and machines by the total number of CDs produced, the share per unit product can be derived. The EMI production site in Uden is about 35,000 m^2, which includes both the production plant and a central distribution centre for Europe. The buildings' average life span is assumed to be 40 years, with restorations necessary after 20 years. About 150 machines with an assumed average weight of about 3,000 kg each are employed in production[18] (usage of energy, water etc. is included in the section on CD production). Based on the figures given above, material intensity can be estimated as follows:

[18] EMI, 17 May 2002. Email from Senta Schiffeleers to Michael Kuhndt.

Box 3-1: Material intensity: Production site

Within the scope of the calculation are: materials required for the building infrastructure, building services technology (e.g. heating system, electric installations) and the machinery. The following key assumptions have been made:

- The life span of the buildings is 40 years
- The life span of the machines is 10 years
- Production output is 160,000,000 CDs/year[19]

	per CD	
abiotic raw materials	0.02	kg
biotic raw materials	0.00	kg
water intensity	0.09	kg

3.3.1.2 CD Production

A standard CD ready to be delivered to the customer comprises a clear jewel box with a dark tray, a printed CD, an inlay and an eight-page booklet printed in 4 colours. The materials involved are shown in Table 3.1

Table 3-1: Description of the "standard CD"[20].

Component	Weight (g)	Material
Jewel Box (clear)	43	Polystyrene (PS) (clear)
Tray (dark)	20	PS (coloured)
CD disc	15	Polycarbonate (PC) + aluminium + printing + lacquer
Inlay	3	Paper (printed 4 colours)
Booklet (8 pages)	16	Paper (printed 4 colours)

In addition to the materials listed in the table, plastic foil might be used for wrapping some individual CDs, and all CDs are packed in cardboard boxes.

The following table lists the materials and resources required for the production of one million CDs, based on EMI figures. Materials not directly used for CD production, such as jewel boxes, booklets, cardboard etc. are procured as finished products. This explains why auxiliary materials, energy and transportation requirements as well as production processes outside EMI's factory gates are not considered.

[19] Uden's output in 2002 was more than 200 million CDs, but the figures provided on the CD production process (see next chapter) date back to 2001. Therefore the output from 2001 is used as reference in this case study.

[20] Krachtwerktuigen Bedrijfsadvisours B.V. (1998). *Roundabout: Closure of the compact disc circle. Reduction of the environmental burden within the compact disc chain*. Final report (short version), 27 October 1998.

Table 3-2: Material and resources inventory for the production of 1 million CDs[21]*.*

Material / Product	**Unit**	**Amount per million CDs**
Energy		
Electricity	kWh	159,484.0
Gas	m^3	5,340.0
Pre-products, Semi-finished products		
Polycarbonate (PC)	tonne	17.3
Aluminium	tonne	0.01
UV-Lacquer (acrylate)	tonne	0.1
Ink	tonne	0.2
Foil (PE)	tonne	1.0
Polystyrene (PS) (jewel boxes)	tonne	67.4
Paper (booklet + inlay)	tonne	23.2
Cardboard (Boxes for 25 CDs)	tonne	4.7
Other process input		
Tap water	m^3	331.2
Methanol	litre	41.6
Acetone	litre	35.3
Screen wash (Ink remover)	litre	60.0
NaHO	litre	187.5
HCl	litre	33.3
H_3PO_4	kg	16.7
Nickel	kg	53.4
Nickelsulfamate	kg	14.1
Glass	kg	0.75

The first step in CD production is the making of a **CD master**, which encompasses several steps, and produces a “stamper” containing the information for the injection moulding process. Materials used in this step are glass, nickel and auxiliary materials. 120 kg of glass was used for the mastering process in 2001, for an annual production of about 160 million CDs. The glass is reused within the process[22] so that its contribution to the total material intensity can be considered to be insignificant. In light of the overall material flows resulting from CD production, the amount of nickel and other auxiliary materials used in this phase of production is negligible[23]. Thus they have not been taken into further consideration.

With respect to the materials used in **CD production** a sensitivity analysis has been conducted in order to identify those that have an influence on overall material intensity. It turns out that plastics (PC, PE, PS), paper (booklet, cardboard) as well as electricity, gas and water have a significant influence on the final result. All other materials contribute less than one per cent to the total and are not considered (see 3.2.1). For example the amount of aluminium used in production contributes only 0.1 per cent to total material intensity.

---

[21] EMI, 22 March 2002.

[22] EMI, 05 March 2002.

[23] Eco-toxicity is not a criterion for the MIPS-methodology applied in the study.

The **transportation** of raw materials and semi-finished products also turns out to be insignificant. Polycarbonate, the major raw material, is sourced in Spain (30 per cent) and Germany (70 per cent), and its transportation contributes about 0.1 per cent to total material intensity. Jewel boxes originating from Belgium and the Netherlands, printwork from the Netherlands and Germany and packaging material from the Netherlands have similarly insignificant material intensities. The largest transport-related contributor is jewel boxes from Hong Kong, transported by ship and truck to EMI. However, even its share does not exceed 0.8 per cent of the total. Given that aspects contributing less than one per cent to total material intensity are not considered (see 3.2.1), the transportation of raw materials and semi-finished products is not included in the final result.

Box 3-2: Material intensity: CD production

Key assumptions that have been made:

- Raw materials and semi-finished products contributing more than one per cent to total material intensity are included
- Energy and water are included
- Transportation of raw materials and semi-finished products are not included

(kg)	abiotic	biotic	water
Electricity	0.25	0.00	10.18
PS Granulate	0.17	0.00	11.06
PC Granulate	0.12	0.00	3.68
Paper	0.20	0.05	5.48
Cardboard	0.01	0.00	5.48
PE foil	0.00	0.00	0.17
Aluminium	0.00	0.00	0.01
Rest	0.01	0.00	0.43
Total	0.77	0.05	31.45

3.3.1.3 Transport and Warehousing CDs

CDs are transported out of Uden and pass to retailers via National Distribution Centres (NDCs) and Parcel Carrier hubs in each country. Normally EMI's NDCs are located close to a major Parcel Carrier hub. The following steps are considered, stating distances estimated by EMI:

1. A large lorry takes CDs from Uden to an NDC in a European country. This is on average about 685 km.

2. CDs are then taken in a large lorry from the NDC to a local hub, where the freight is moved to another truck. This is estimated to be on average about 20 km.

3. A variety of sizes of vehicle are used in phase 3 which takes CDs from either

    a. hub to retail outlet (small truck) or

    b. hub to depot (on a large lorry) and then depot to retail outlet (again small vehicle).

    Whether a or b, the distance travelled is approximately 295 km.

4. The average distance that a CD is transported from retailer to customer is between 2 and 10 km according to EMI's estimation. For the purpose of this study a travel distance of 5 km one way (= 10 km in total) is assumed. This reflects findings from other studies on the average distance travelled in Germany[24].

Road is the most common means of transporting CDs from manufacturer to retailer. For the calculations it is assumed that large trucks (24t cargo) transport 150,000 CDs and small trucks (8t cargo) transport 50,000. Using these figures and assuming a return trip, transportation from manufacturer to retailer (steps 1 to 3) has a material intensity of 0.0053 kg abiotic + biotic raw materials per CD (or 0.7 per cent of the total) and is not included within the scope of the case study (see 3.2.1).

Transporting a CD from the retailer to the consumer's home often takes place as part of a multi-purpose shopping trip. Since shopping by car makes up the majority of trips, it is seen as a default means of transport. Each shopping trip is assumed to include three activities, meaning that CDs cause only one third of the resource consumption, which amounts to the following:

Box 3-3: Material intensity: Transport retailer to consumer

Key assumption made:

- Total trip distance: 10 km
- Activities per trip: 3
- Mode of transport: average car

	per CD	
Abiotic raw materials	0.28	kg
biotic raw materials	0.00	kg
Water intensity	1.92	kg

Warehousing

CDs not only need to be transported, but also stored at the National Distribution Centre. Storage at the transporter's hub is not considered, since the CDs are usually not stored there. Figures for the size and turn-over rate of NDCs are based on average values for EMI's European distribution network.

24 Schallaböck, K.O. (1996). *Verkehr und Zeit* [traffic and time]. In Rinderspacher, J.P. (Ed.) (1996). Zeit für die Umwelt [time for the environment]. Edition sigma, p. 175 – 212.

Box 3-4: Material intensity: National Distribution Centre

Key assumptions made:

- Average size: 6,670 m^2
- Average CD throughput: 17,667,000 CDs/year
- Building life time: 40 years
- Included: Restoration, energy and water

	per CD	
Abiotic raw materials	0.07	kg
biotic raw materials	0.00	kg
Water intensity	0.83	kg

3.3.1.4 CD shop

CDs are sold in different types of shop and location - from specialised CD shops to large department stores or even petrol stations. Considering this, only a very rough estimate of the material intensity of this phase is possible. It proved to be difficult to find information on floor space and turn-over rates of CD shops, however information from a book retailing chain could be obtained. In the absence of alternative information and acknowledging that selling books and CDs are somewhat similar but still different businesses, this information has been used. However, some changes were made relating to the turnover of media. While the book retail chain sold about 3.3 million items (books, journals etc.) per year, it is assumed that the turnover in CD shops of a similar size would be closer to 10 million per year[25].

Box 3-5: Material intensity: CD shop

Key assumptions made:

- CD turnover: 10 million per year
- Total building space (7 branches): 23,751 m^2
- Consumption for heating, electricity and water are included

	per CD	
Abiotic raw materials	0.43	kg
Biotic raw materials	0.03	kg
Water intensity	5.23	kg

[25] The figures originate from a bookshop chain known for its "open shop-floor design", inviting people to stroll around, sit down, read etc. CD shops are usually less floor intense. In addition, books have different sizes, but are in average larger than a CD.

3.3.1.5 Disposal and Recycling

Even though CDs are durable consumer goods, eventually most of them will end up as waste. For plastic components, accounting for 80 per cent of the total weight, incineration is currently the most likely method of treatment[26]. Paper is not included in the incineration stream, since it is expected to be recycled; ink, aluminium etc. are attached to the disc and therefore included in the 80 per cent. It turns out that the disposal stage is of no relevance to the final result. With 0.004 kg abiotic + biotic raw materials (0.5 per cent of the total) this stage is excluded from the final result (see 3.2.1).

3.3.2 Online Shopping Scenario

The online shopping scenario has many similarities with the physical retail scenario, with three main differences. First, instead of a CD shop, online retail warehouses need to be considered. Second, consumer shopping trips are replaced by a parcel delivery service. Third, the IT usage for ordering the CD needs to be included. The other steps remain the same as in the previous scenario.

3.3.2.1 Transport and Warehousing

In addition to the NDCs outlined in the physical retail scenario, the online retail warehouses need to be considered. It has not been possible to find relevant information, so the figures available for NDCs have been used as a proxy (see 3.3.1.3).

The transportation demand is largely similar to the physical retail scenario. For reasons of comparability, it is assumed that the transport distance given for the previous scenario represents the demands of this one as well. Delivery from the online retailer's warehouse to the final customer by post or parcel services is not included, since a CD makes up only a tiny fraction of the goods to be transported and its total material intensity is consequently insignificant.

3.3.2.2 IT Infrastructure

This section encompasses IT devices used by customers (PC and monitor) as well as the internet infrastructure required to transfer the online order.

Key to the MIPS concept is measurement of the material intensity of a product or service in each phase of its life cycle. So, for home IT equipment, the material intensity of the production and use phase are included in the analysis. When it comes to the entire internet infrastructure (server, router, cables etc.), estimates also cover the production and usephase, but with a lower level of data quality. While information relating to energy consumption in the use phase is considered to be sufficient, estimates for the production phase should be treated more carefully. This is because studies attempting to quantify the material intensity of the different products do not yet exist. In the absence of other studies, a rough estimate of material intensity has been conducted based on EITO[27] figures, which is likely to underestimate the true value. Due to lack of data, the end of life phase is excluded. Experience from other products tells us that, in the context of life-cycle wide material flows, end of life is of limited significance.

---

[26] Most of the CDs sold to date have not as yet entered the waste stream. The most likely future treatment processes (e.g. material recycling, energy recycling, …) of this waste stream is not known.

[27] European Information Technology Observatory. (2002): European Information Technology Observatory 2002.

A crucial factor is the time taken for the online transaction as this determines not only the electricity consumption but also the material intensity of an individual action (the online order) as a share of total material intensity. A study by Nielsen NetRatings found that the average visitor to top music internet sites in November 2001 spent between 11:51 min (bestbuy.com) and 19:00 min (amazon.com) online.

Table 3-3: Average minutes per visitor to top (music) internet sites in November 2001[28].

Site	**Minutes**
bmgmusicservice.com	20:22
amazon.com	19:00
bet.com	17:48
half.com	13:59
cdnow.com	13:06
bestbuy.com	11:51
mp3.com	11:35

From this we can assume that it takes 15 minutes to search for and order a CD online.

Having determined the time required to place a single online order, we need to determine total usage for ICT equipment throughout its lifetime[29]. Assuming that a PC is used for about 4 years in private households, it is frequency of use that defines the total usage time of the computer. Yet, user types and usage patterns seem to vary. A large part of the population has never used any internet application, but an increasing number have taken their first timid steps and for others it is a daily means of communication. In order to cover these different patterns it is necessary to define certain user groups with typical patterns. This has been done on the basis of two existing studies. MediaGruppe Digital estimates the total number of internet users in Germany to be 22.2 million, a third of the population[30].

Table 3-4: Internet usage pattern in Germany.

Daily		**Several times**		**Once week**		**Less**		**Source**
% Pop.	% User	% Pop	% User	% Pop	% User	% Pop	% User	
13.4		12.6		4.4		4.4		MediaGruppe Digital, 2001
	34		37		16		14	MediaGruppe, 2000

[28] Nielsen NetRatings. (2001). *Average minutes per visitor to top internet sites in November 2001.* In: Croner & Byson. (2002). *Music for Hire: Will subscription boost online sales*? Broadband Media.

[29] Data sources employed to identify the usage pattern take only German figures into account. Ultimately, these figures are needed to calculate the resource intensity per hour internet usage (see box 3-7). Yet, studies looking at the Internets resource consumption in Europe are only known for Germany, so that German usage patterns needed to be taken into account.

[30] MediaGruppe Digital. (2001). *@factsmonthly – Januar 2001*. Unterföhringen, Germany: MediaGruppe Digital.

The usage pattern that emerges is that roughly one third uses the internet on a daily basis, one third several times a week and the last third once a week or less. Thus, we can distinguish three types of internet user:

1. Power user: uses the internet on a daily basis
2. Normal user: uses the internet 4 times a week
3. Infrequent user: uses the internet once a week

Average usage per session has been estimated at 48 minutes by Infratest Burke in 2000[31], and 62 minutes by MediaGruppe Digital for 2001 (both figures for Germany). These surveys indicate that an average usage time of one hour per session reflects current reality. But private computers are not only used for internet applications. Studies relating to average usage patterns for private PCs (i.e. time spent text editing, time spent using internet applications etc.) could not be found, so assumptions have been made. Excluding all PCs without internet access, it is assumed that internet applications account for one third of the running time of a private PC.

Based on this information, it is possible to calculate the time spent placing an online order as a share of the material intensity for the production of a PC and monitor.

Box 3-6: Material intensity: Consumers PC + monitor (production)

Key assumptions made:

- Total life-time PC: 4 years
- Usage pattern: 4 times a week for 1 hour each (normal user)
- Online time required per order: 15 min
- Only the materials employed in production are considered

	per order	
Abiotic raw materials	0.14	kg
Biotic raw materials	0.00	kg
Water intensity	5.40	kg

The next step is to consider the material consumption related to the electricity consumption plus internet usage. Taking the 15 minutes required for shopping as mentioned before, different approaches can be used to estimate the material intensity of the use-phase. The simplest picture would be to take an average PC's electricity consumption of about 125 to 150 W and to calculate the electricity demand to run this system for 15 minutes (0.03 kWh).

[31] Infratest Burke. (2000). *internet-Nutzung nach Dauer in Prozent der internet-Nutzer 2000 in Deutschland* [Length of internet usage in Germany 2000]. Quoted in: Bundesministerium für Wirtschaft und Technologie [German Federal Ministry of Economics and Technology]. (2001). *Monitoring Informationswirtschaft* [Monitoring Information Economics] – study by Infratest Burke GmbH & Co. and the Institute for Information Economics. Berlin: BMWi.

Applying the material intensity factors for the average OECD power mix, one would get the material intensity of running the PC.

But it is not only the home PC system the customer is using for his online order; he is also employing parts of the internet infrastructure. Therefore the internet's resource consumption (production of devices + energy during use phase) needs to be considered as well. Two European studies have been identified that try to estimate the internet's total electricity consumption. Barthel et al. estimated the power consumption of the German internet infrastructure, also covering the devices used by private customers to access the net[32]. Taking their figures, one hour of internet access consumes, including the customer's PC system, 0.51 kWh of electricity. This figure will serve as basis for the calculation in this case study. The second study is discussed in box 3-8.

As for the private PC, it is not only the use-phase, but also the resources required for producing all the devices the internet is built of that needs to be considered. While an estimate of the number and type of devices that constitute the internet is already a challenge, an assessment of its total material intensity is an even bigger one. Nevertheless a first, yet rough estimate by the Wuppertal Institute based on EITO[33] statistics for IT device shipments resulted in 0.2 kg abiotic + biotic raw materials per hour of internet usage just for producing the equipment. The figure should be robust enough to indicate the general order of magnitude and is therefore used in the following.

Translating what has been said above into material intensities for 15 minutes of internet use amounts to:

Box 3-7: Material intensity: Consumer's PC + internet usage (use phase)

Key assumptions made:

- 15 minutes of internet usage requires about 0.12 kWh electricity (1 hour 0.51 kWh; includes internet and user's equipment)
- resource flows caused during the internet equipment's production amounts to 0.05 kg abiotic + biotic raw materials when 15 minutes of online time is assumed.
- The materials required to produce the user's IT equipment are not included (see box 3-6).

	per order	
abiotic raw materials	0.25	kg
biotic raw materials	0.00	kg
water intensity	8.13	kg

[32] Barthel, Claus, Lechtenböhmer, Stefan & Thomas, Stefan. (2001). *GHG Emission Trends of the internet in Germany*. In Langrock, Thomas, Ott, Hermann E. & Takeuchi, Tsuneo. (2001) *International Climate Policy & the IT-Sector* (55-70). Wuppertal, Wuppertal Spezial 19, Wuppertal Institute.

[33] European Information Technology Observatory. (2002): European Information Technology Observatory 2002.

Box 3-8: Alternative Setting:
Material intensity consumer's PC + internet usage (use phase)

Please note: Boxes describing alternative settings vary assumptions taken in order to highlight some of the factors that influence results. Figures and findings from these boxes are not taken into consideration in the final result.

A second study estimates the resource intensity of the internet infrastructure[34]. Due to major uncertainties and data gaps in the field of research, the author concludes that estimations of the material intensity of the entire infrastructure (including the materials employed in the production and end-of-life treatment of all IT devices) proved to be too difficult, but an estimate for the use phase (electricity consumption) was possible. Two scenarios – a best- and worst-case - are put forward, indicating electricity consumption for the entire infrastructure ranging from 0.39 to 2.35 kWh, depending on assumptions and boundaries. Taking the mean of 1.37 kWh, material intensity would be as follows:

	per order	
abiotic raw materials	0.59	kg
biotic raw materials	0.00	kg
water intensity	21.85	kg

3.3.3 Digital Delivery Scenario

The digital delivery scenario could be entirely rooted in the digital world, so that most of the process steps introduced in the previous scenarios would be obsolete. Yet the picture changes if the downloaded files are burnt on to a CD-R. Currently consumers tend to store downloaded music files not only on hard-drives, but also on CDs as a back up and as a way of sharing them with other people. For the foreseeable future CD burning is expected to remain an important storage option (see also future scenarios in chapter 5).

To cover both possibilities, different digital delivery scenarios are outlined. The **partial capacity usage scenario** is based on the assumption that consumers download compressed files and store them on a CD-R. 56 minutes of music in compressed format takes up something like 56 MB, or eight per cent of a 700 MB CD. For this reason only eight per cent of the material intensity related to a CD as well its production, distribution etc. are included. The **pure download scenario** assumes that the files are not burned, while the **full capacity scenario** takes 100 per cent of the CD-R and related consumption (production, distribution etc.) into account – assuming that once the content is burned, the CD-R is then not re-used.

It must be acknowledged that neither the partial nor the full capacity scenario are likely to represent reality in most cases. Users tend to use up more than just eight per cent of a CD, but less than 100 per cent. If more than just 56 MB are burnt onto a CD-R, the relative share of the material intensity of the CD-Rs would change. Taking these uncertain factors into

[34] Türk, Volker. (2001). *Assessing the Resource Intensity of the Internet Infrastructure: Data Analysis for a Material-Flow Oriented Approach and First Results on Electricity Consumption*. M. Sc. thesis at the Lund University, Sweden. [Online]. Available at: http://www.iiiee.lu.se/information/library/publications/2002/volker.html.

consideration, the two burning scenarios chosen represent a range. In most cases, reality will be somewhere in between.

3.3.3.1 CD-R Production

The differences between pre-recorded CDs produced at EMI and blank CDs have been identified from general descriptions of the CD-Rs production process provided by EMI and the Optical Storage Technology Association (OSTA), a trade organisation representing the leading producers of optical storage worldwide.

CD-R manufacturing is similar to pre-recorded CD injection moulding, with a few differences. Compared to pre-recorded CDs, CD-R have an additional metal layer but the printing is less intense. Since these differences are of no relevance from a material intensity point of view, they are not discussed any further. The relative unimportance of the aluminium, lacquer and ink application in pre-recorded CDs also applies to CD-Rs. It is assumed that the CD-Rs are sold in a jewel box but the booklet is not included.

Current CD-Rs have a capacity of 700 MB, so they can store much more than just 56 MB of music. Hence unlike the pre-recorded CD described in the physical retail scenario, only a fraction (56 MB is 8 per cent of the total capacity) of the CD-R's material intensity is taken into account in this scenario. On the other hand one could argue that a full CD-R is required regardless of whether only one MB is used or the entire capacity. This argument is covered by the full capacity usage scenario.

Box 3-9: Material intensity: CD-R production

Key assumptions made:

- Material intensity figures taken from the pre-recorded CD excluding figures for the booklet
- Calculations based on partial capacity usage scenario

	Partial usage	**Full usage**	
abiotic raw materials	0.05	0.56	kg
biotic raw materials	0.00	0,00	kg
water intensity	2.08	25.97	kg

3.3.3.2 Production Site, Transport and Warehousing, Retail

As for the pre-recorded CDs, the production site, transport and warehousing as well as shopping need to be taken into account. Since no information was available about whether the CD-R distribution chain is different from the one for pre-recorded CDs, data for the latter has been used and adjusted. The following assumptions have been used[35]:

[35] For the partial capacity usage scenario eight per cent of the figures are taken into account, while the full capacity scenario uses 100 per cent.

Production site: Results from EMI's site in Uden (see 3.3.1.1).

Warehouse: Results from the NDC (see 3.3.1.3).

Retail outlet: Unlike pre-recorded CDs, CD-Rs are most frequently sold in bulk. It has been assumed that CD-Rs are sold in packs of ten. Figures for the CD shop (see 3.3.1.4) are therefore divided by ten.

Transport: Information based on the figures described in section 3.3.1.3. The material intensity of consumer transport is divided by ten for the reasons set out above.

Disposal: Information based on the figures described in section 3.3.1.5.

3.3.3.3 IT Infrastructure

As for the online shopping scenario, access and download times need to be taken into account. The length of time needed to select and download 56 minutes of music (the service unit) depends to a large extent on the type of connection used. But in addition to the download time, time is spent searching for and accessing the web-portal and searching and paying for songs of interest.

The first factor to determine is the file size. It is assumed that 56 minutes of music represents 56 MB of data. Downloading 56 MB of data can take slightly more than 1 minute or almost 4 hours, depending on the type and speed of connection in question. Possible options are:

a. **56 k Modem**

Bit rate:	56 kBit/sec
theoretical download:	7 kByte/sec
realistic download:	4 kByte/sec
time to download 56 MB:	14000 sec or 233 min

b. **DSL (broadband)**[36]

Bit rate:	768 kBit/sec
theoretical download:	96 kByte/sec
realistic download:	60 kByte/sec
time to download 56 MB:	933 sec or 15.30 min

c. **10 Mbit Ethernet**

Bit rate:	10000 kBit/sec
theoretical download:	1250 kByte/sec
realistic download:	800 kByte/sec
time to download 56 MB:	70 sec or about 1 min

Broadband access is becoming more widespread (see future scenarios) and it seems likely that consumers with broadband access will make more use of downloadable music than those equipped with a 56k modem connection. Therefore the broadband option will be used for this study. But the actual download represents only the last step when purchasing online

---

[36] DSL (Digital Subscriber Line) is a technology for bringing high-bandwidth information over ordinary copper telephone lines.

music. As with the online shopping scenario, accessing the website, searching for music and placing an order need to be taken into account as well. Figures from mp3.com (see table 3-3) will be used for this purpose. The total online time required adds up to: 15.30 minutes (DSL connection) + 11.35 minutes = about 27.30 minutes. Calculating the material intensity based on the assumptions and figures presented in section 3.3.2.2, results in:

Box 3-10: Material intensity: Download

Key assumptions made:

- 27.30 mins internet usage requires 0.23 kWh (1 hour 0.51 kWh; includes network and client side IT equipment)
- 0.09 kg abiotic + biotic raw materials for the production of Internet devices are included
- The materials required to produce the user's IT equipment are not included (see box 3-6)

	Per order	
abiotic raw materials	0.46	kg
biotic raw materials	0.00	kg
water intensity	14.71	kg

Box 3-11: Alternative Setting[37]:
Material intensity – digital download

As highlighted above, several assumptions can be made about download time and electricity consumption per hour, which have a significant influence over the final result. Using a 56k modem instead of a DSL connection would increase the download time to almost four hours, resulting in the following material intensities:

	Per order	
abiotic raw materials	4.14	kg
biotic raw materials	0.00	kg
water intensity	132.82	kg

In order to highlight the potential range of results, a "worst-case scenario" is presented below. Here a 56k modem connection and much higher electricity consumption per hour of internet access, as presented by Türk (see 3.3.3.3), are used:

	per order	
abiotic raw materials	9.69	kg
biotic raw materials	0.00	kg
water intensity	356.79	kg

.

The material intensity resulting from the consumer's IT infrastructure is based on the information presented in chapter 3.3.2.2. The only difference is that people downloading music files are more likely to be power users than normal users. (see Table 3-4).

Box 3-12: Material intensity: Consumer's PC + monitor (production)

Key assumptions made:

- Total life span of PC: 4 years
- Usage pattern: 7 times a week for 1 hour each
- Online time required per download: 27.30 min
- Only the materials employed in production are considered

	per order	
Abiotic raw materials	0.14	kg
Biotic raw materials	0.00	kg
Water intensity	5,58	kg

[37] Please note: Boxes describing alternative settings vary the assumptions taken in order to highlight some of the factors influencing results. Figures and findings from these boxes are not taken any further and are not used in the final results.

For the two digital delivery scenarios that include CD burning, the following steps also need to be included. CD burners which burn data 16 times faster than the playing speed of a CD are now standard in PC systems. Burning 56 MB at this speed takes only 24 seconds. An additional 2 minutes is included for getting the computer up and running. This gives the following result:

Box 3-13: Material intensity: CD burning

Key assumptions made:

- PC system usage figures as above: life-span 4 years, usage 7 times a week for 1 hour
- Time required: 2.30 minutes
- PC power consumption: 150 W

	per order	
abiotic raw materials	0.02	kg
biotic raw materials	0.00	kg
water intensity	0.88	kg

The infrastructure needed to produce downloadable or “streamable” files consists predominantly of additional computers (for encoding etc.) and servers for data storage and backup. Taking OD2 as an example, all files are backed up on DAT tapes as wav-files[38] each with 6 to 7 archive copies of different qualities. In total, approximately 600 MB need to be stored per album[39]. Estimating the material intensity of these devices is problematic for three reasons:

- It is hard to obtain information about the use of IT equipment in the relevant business sectors.
- Most businesses in this area are start-ups, so their business environment, including their use of IT infrastructure, changes rapidly.
- It is difficult to assess the material intensity of IT equipment in general, as highlighted in chapter 3.3.2.2.

The material intensity of the IT infrastructure used by business to deliver digital downloads covers a large number of downloads or streams, so the share per service unit is likely to be small. Business IT infrastructure has not been taken into account in previous scenarios, and given the uncertainties outlined above, IT requirements have also been discounted in the download scenario.

[38] Unlike MPEG and other compressed formats, WAVs store samples "in the raw" where no pre-processing is required other that formatting of the data. Data storage space is about 10 times higher than in MPEG based storage formats.

[39] EMI, 22 March 2002.

3.4 Results

This chapter summarises the results discussed in the previous chapter. Despite the fact that biotic raw materials are relatively unimportant in the overall context, in most cases, results will refer to the aggregate amount of abiotic (non-renewable) and biotic (renewable) raw material. Together non-renewable and renewable raw materials represent the total amount of material required.

3.4.1 Physical Retail Scenario

Table 3-5: Overview of results for the physical retail scenario.

Material intensity - physical retail scenario					
	abiotic	biotic	water	abiotic + biotic	
	kg	kg	kg	kg	%
CD production	0.77	0.05	31.45	0.82	50
Production site	0.02	0.00	0.09	0.02	1
National Distribution Centre	0.07	0.00	0.83	0.07	4
CD Shop	0.43	0.03	5.23	0.46	28
Transport goods	- *	-	-	-	0
Transport by consumer	0.28	0.00	1.92	0.28	17
Disposal	- *	-	-	-	0
Total	1.56	0.09	39.52	1.64	100

* Material intensity is less than one per cent of the total and, therefore, in accordance with the study scope (see 3.2.1) is not considered.

It turns out that the CD and the shop have the largest impact in the entire life cycle, followed by consumer transport. Due to the large number of CDs produced, the production infrastructure is relatively unimportant.

3.4.2 Online Shopping Scenario

Table 3-6: Overview of results for the online shopping scenario.

Material intensity - online shopping scenario					
	abiotic	biotic	water	abiotic + biotic	
	kg	kg	kg	kg	%
CD production	0.77	0.05	31.45	0.82	59
Production site	0.02	0.00	0.09	0.02	1
National Distribution Centre	0.07	0.00	0.83	0.07	5
Online retailer warehouse	0.07	0.00	0.83	0.07	5
Transport goods	- *	-	-	-	0
Consumer PC materials	0.14	0.00	5.40	0.14	10
Online order (electricity+ materials internet devices)	0.25	0.00	8.13	0.25	18
Disposal	- *	-	-	-	0
Total	1.31	0.06	46.73	1.37	100

* Material intensity is less than one per cent of the total and, therefore, in accordance with the study scope (see 3.2.1) is not considered.

The results for the online shopping scenario look similar to the ones for the previous scenario. The most important difference is that the customer order makes a significant contribution to resource flows (consumer's PC + online order), accounting for about 30 per cent of the total.

3.4.3 Digital Delivery Scenario

Table 3-7: Summary overview of the results for the digital delivery scenario.

Material intensity - Digital delivery scenario

	Main Scenario: Partial capacity usage					**Full capacity usage**					**Pure download**				
	abiotic	Biotic	Water	abiotic + biotic		abiotic	biotic	water	abiotic + biotic		abiotic	biotic	water	abiotic + biotic	
	kg	kg	Kg	kg	%	kg	kg	kg	kg	%	kg	kg	kg	kg	%
CD-R production	0.05	0.00	2.08	0.05	7	0.56	0.00	25.97	0.57	42	-	-	-	-	0
Production site	- *	-	-	-	0	0.02	0.00	0.09	0.02	1	-	-	-	-	0
Warehouse	0.01	0.00	0.07	0.01	1	0.07	0.00	0.83	0.07	5	-	-	-	-	0
Retailer shop	- *	-	-	-	0	0.04	0.00	0.52	0.05	3	-	-	-	-	0
Transport goods	- *	-	-	-	0	- *	-	-	-	0	-	-	-	-	0
Transport by consumer	- *	-	-	-	0	0.03	0.00	0.19	0.03	2	-	-	-	-	0
Consumer PC materials	0.14	0.00	5.58	0.14	21	0.14	0.00	5.58	0.14	10	0.14	0.00	5.58	0.14	24
Download (electricity + materials internet devices)	0.46	0.00	14.71	0.46	68	0.46	0.00	14.71	0.46	34	0.46	0.00	14.71	0.46	76
CD burning	0.02	0.00	0.88	0.02	3	0.02	0.00	0.88	0.02	2	-	-	-	-	0
Disposal	- *	-	-	-	0	- *	-	-	-	0	-	-	-	-	0
Total	0.67	0.00	23.31	0.67	100	1.34	0.01	48.77	1.36	100	0.60	0.00	20.29	0.60	100

* Material intensity is less than one per cent of the total and, therefore, in accordance with the study scope (see 3.2.1) is not considered.

The digital delivery scenario has the highest potential variation between results. If music is not burnt on to a CD-R (pure download), only the online transaction and material intensity of the PC need to be considered. However, these figures can vary considerably depending on the assumptions made (e.g. type of connection). Nevertheless, the partial capacity usage scenario as well as the pure download scenario are clearly less resource intensive than the physical retail and the online shopping scenario. The full capacity scenario has a similar material intensity as the online shopping scenario.

Box 3-14: Alternative Setting[40]:
Material intensity – Digital distribution scenario with slow download speed

The importance of the download speed (and hence download time) has already been highlighted. To further illustrate this point, this scenario assumes a 56k modem connection for the download, while all other factors stay the same:

	Main Scenario: partial capacity usage				
	abiotic	biotic	water	abiotic + biotic	
	kg	Kg	kg	Kg	%
CD-R	0.05	0.00	2.08	0.05	1
Production site	- *	-	-	-	0
Warehouse	- *	-	-	-	0
Retailer shop	- *	-	-	-	0
Transport goods	- *	-	-	-	0
Transport by consumer	- *	-	-	-	0
Consumer PC materials	1.28	0.00	50.36	1.28	23
Download (electricity+ materials internet devices)	4.14	0.00	132.82	4.14	75
CD burning	0.02	0.00	0.88	0.02	0
Disposal	- *	-	-	-	0
Total	5.50	0.00	186.20	5.50	100

* material intensity is less than one per cent of the total. Therefore, in accordance with the study scope (see 3.2.1) not considered.

3.5 Discussion & Conclusion

The methodology

The methodology used (MIPS) proved to be suitable to quantify the resource consumption of digital music. MIPS is based on a life cycle wide approach and covers material flows from raw material extraction to service provision and end-of-life treatment, including the influence of customers habits. “Reducing” normally incomparable factors within the life cycle, e.g. electricity consumption in production and building infrastructure, to their material content allows comparison on the basis of a common unit. This unit (material intensity) helps identify important factors from an environmental perspective. Knowledge of these factors in turn helps prioritise efforts to reduce the overall environmental effects of the music sector.

[40] Please note: Boxes describing alternative settings vary assumptions taken in order to highlight some of the factors influencing results. Figures and findings from these boxes are not taken any further and are not used in the final results!

The case study

In those scenarios that include a physical product (the CD), production sites contribute a relatively small amount to overall material intensity. This has to do with efficiencies resulting from high production volumes. However, for **buildings** with a lower turn-over of CDs (such as National Distribution Centres and CD shops), building infrastructure turns out to be of overall importance. **Transportation** between producer, retailer and consumer is also significant in parts. Due to scale effects[41] the first stage in the transport chain is insignificant. But this cannot be said for the second. Consumer trips by car are the third highest contributor to material intensity in the physical retail scenario.

In case of pure digital delivery, the material intensity depends very much on the framework assumptions made. Excluding CD burning and assuming a fast internet connection, this scenario is clearly beneficial from a material intensity point of view. However, if the content is burnt onto a CD-R or a slow connection are assumed, digital delivery is less beneficial and could even be more material intense.

A life cycle wide study on the environmental burden of the compact disc chain concluded that the largest environmental burden is caused in the production phase[42]. While this remains true for the physical retail scenario, the picture starts to change in the case of online shopping. CD production remains the largest single contributor (abiotic raw materials 0.77 kg, biotic raw materials 0.05 kg), but **consumer behaviour** becomes more relevant (from 0.28 kg in the physical retail for transport to 0.39 kg abiotic raw materials in the online shopping scenario for placing an order). In the digital delivery scenario (full capacity usage), the balance tips even more towards the consumer.

The case study did not look at music streams, since downloads appear to be the emerging model. Streams, unlike downloads, are not permanently stored on the consumer's computer, so internet access is required to listen to them each time. By just looking at the material intensity of a single download, it can be concluded that, as long as a song is listened to more than once, streams will be more material intense than downloads.

[41] Figures from EMI state, that per one million CDs, 2,967 litres of diesel are used for transportation, which would result in roughly 150,000 CDs transported by a large truck over a distance of about 700 km (one way). Additional 300 km with small trucks (one way) from the production site to the retailer are accounted for.

[42] Krachtwerktuigen Consultancy. (1997). *Roundabout: Closure of the compact disc circle. Reduction of the environmental burden within the compact disc chain*. Interim report, 18 December 1997.

Box 3-15: Comparison of the results

Comparing the three scenarios, the figures tell only one story. Digital distribution (c) appears to be beneficial, with about 50 per cent less resource consumption than the other two scenarios. The physical retail (a) and online shopping (b) scenarios have similar impacts, with the online shopping scenario having a slightly lower material intensity. But the material benefits of digital distribution depend on the underlying assumptions. E.g. with a slow internet connection digital delivery can be up to several times more material intense than its physical counter-part (d). At the macro-level, the uncertainties linked to consumer behaviour make it difficult to recommend one delivery method over another. The table below highlights the three highest contributors to total material intensity (abiotic raw materials) in the scenarios assessed.

Table 3-4: Summary overview of the three highest contributors to total material intensity (abiotic raw materials).

	Physical retail (a)	Online shopping (b)	Digital distribution (partial capacity (c)	Digital distribution (alternative settings) (d)
	abiotic (kg)	abiotic (kg)	abiotic (kg)	abiotic (kg)
CD/CD-R	0.77	0.77	0.05	0.05
Production site				
NDC/ Warehouse				
CD shop/ Retailer shop	0.43			
Transport goods				
Transport by consumer	0.28			
Consumer PC materials		0.14	0.14	1.28
Download		0.25	0.46	4.14
CD burning				
Disposal				
Total	1.56	1.31	0.67	5.50

The sector

At a general level, it is possible to say that digital delivery as compressed download files is environmentally preferable, even if the files are burned onto a CD, assuming that a fast internet connection is used and that this does not lead to greater consumption of music downloads in general (rebound effect). A different set of assumptions might reverse this conclusion. Slow connections, inefficient burning of CDs (e.g. using an entire CD-R for only a few files), unselected downloads etc. will lead to higher resource consumption than in the physical retail or online shopping scenario. Consumer behaviour will influence if, and to what extent, potential savings will be realised. Some of these factors are beyond the control of the music industry, but the sector can play a role in steering consumer behaviour by trying to shape certain framework conditions, such as the digital offering available to consumers. It has already been pointed out that music streams are unfavourable compared to downloads from a material intensity point of view (see section above) if the consumer listens to a song more than once. The sector could therefore promote downloads rather than streams. In an online world, subscription models that allow unlimited access to music files are also unfavourable from an environmental perspective. They are likely to promote unselected downloads in vast numbers. Other models that encourage users to be more selective are preferable.

If rebound effects are included, the picture changes once again. For example, consumers with fast internet access may be more likely to use their PC more frequently, to stay online all the time or to download more music, thereby increasing the material consumption from a macro perspective. The enormous quantity of illegally downloaded music files already accounts for significant material flows. If the music industry succeeds in shifting the demand for downloaded music from illegal to legal consumption models and there is some substitution of digital downloads for CDs, then resource savings could be made. These effects are still poorly understood and further research in this area is needed.

4. The Social Dimension of Digital Music

4.1 Objectives

The column inches that have been dedicated to digital music in the last three years make it easy to forget that we are still at an early stage in the development of the internet as a delivery channel for music. After all, the internet itself is barely a teenager. In these early days, things are still in a state of flux. The music industry is constantly responding to changes in technology and experimenting with new initiatives; policymakers are reviewing regulatory and legal frameworks; artists are exploring new ways of making music; and consumer behaviour is evolving in response to new offerings. It is a difficult time to assess the social impacts of digital music, but it is in the early stages of the uptake of digital technology that we must consider the social innovation necessary to create a sustainable Information Society.

This case study aims to:

- Scope out the possible impacts and opportunities of digital music
- Assess how these affect the social role of music
- Consider the implications for corporate social responsibility in the music industry

Music is a component of many industries, from retailing and hardware manufacture to internet service provision and mobile telephony. This case study focuses primarily on the recorded music industry, although some of the recommendations include music publishing and rights management.

In discussing digital music, the case study considers both the distribution of music via digital networks such as the internet, as well as the use of digital technology in the production of music.

4.1.1 Methodology

The social part of this case study draws on desk-based research and consultation with numerous people at EMI, including:

Claudio Aspesi, SVP Strategic Planning

Kate Dunning, VP Environmental Affairs

Ian Durndell, Director New Media

Gareth Hopkins, SVP Legal and Business Affairs

Sara John, VP Government Affairs

Doug Lucas, VP New Media

Jay Samit, SVP New Media

Caryn Tomlinson, Director Artist Relations

An expert seminar was also held in October 2002 to gather wider input and opinions from senior representatives from the recording industry, the music publishing industry, other creative industries, technology companies, producers, songwriters and artists. The following individuals attended the seminar.

Paul Brindley, MusicAlly / Music Publishers Association
Ben Drury, Head of Music, BT Openworld
Fergal Gara, New Media Director, EMI Recorded Music UK & Ireland
Sara John, Government Affairs, EMI

Korda Marshall, Managing Director, Mushroom Records UK

Peter Martin, Ealing Studios

James McMillan, Producer, songwriter, classically trained musician

Eric Nicoli, Chairman, EMI

Mike Peden, Artist, producer, songwriter

Jonathon Porritt, Programme Director, Forum for the Future

Ajax Scott, Editor in Chief, Music Week

Caryn Tomlinson, Director of Artist Relations, EMI Recorded Music

Chris Vanstone, Design and Innovation, Design Council

In the next section we look at the social impacts of music before considering how these will be affected by the emergence of digital music.

4.2 The social life of music

Music accompanies our lives - in the car, in the supermarket, in restaurants, even at work. In the UK alone, we spent £250 million on music between January and March 2002 (BBC Online, 17th May 2002). 75 per cent of people listen to at least one hour of music a day (Cole, xxxx), and 50 per cent of young people listen to nearly two and a half hours a day (North et al, 2000). Some of us are performers and creators as well as listeners. Between 24 and 30 per cent of adults in the US play a musical instrument (Ref). We use music to relax, to convey emotion, to sell products, to pacify people in queues, to rehabilitate the sick and communicate with the excluded. Music is both an individual pastime and an inherently social activity.

Numerous studies show that music affects mood. It can raise a smile, produce a tear, steady nerves or make the heart race. However, linking particular musical structures to particular moods is more difficult. The same piece of music will often affect different people in contrasting ways (DeNora, 2000). The emotional quality of music has been used for therapeutic reasons for centuries. Music has been shown to bring relief and benefit to sufferers of numerous conditions, including the terminally ill. It also brings demonstrable benefits to individuals with mental and behavioural disorders. Music can be a safe channel through which to express emotion. Adolescents who report a high frequency of personal problems are likely to turn to music for comfort and tend to spend more time listening to music. A study conducted among 2465 adolescents in England found that music is important to young people because it satisfies their emotional needs and allows them to "portray an image to the outside world" (North et al, 2000).

Musical preferences are wrapped up with identity. The music you listen to tells the world something about you. Music, and the personalities associated with it, provide fans with a sense of identity and belonging, particularly genres such as rap, heavy metal and punk which have an identifiable look and culture. For young people, particularly those who lack other role models, such personalities can fill an important gap. The popularity of anti-establishment forms of music like rap is often an attempt to assert individual identity independent of the expectations of parents and wider society. Such music has been criticised for eliciting anti-social behaviour among young people, but there is no evidence to suggest a direct link between listening to subversive lyrics and anti-social behaviour.

For centuries, music has accompanied social activity whether folk festivals or religious rituals. The earliest cave paintings depict dancing figures playing pipes. Music provides a powerful channel of communication, binding communities together through cultural understanding. This can make it a powerful vehicle for the preservation of minority cultures. It can also cross boundaries, building bridges of understanding between communities. In its "On the Line" education programme, Oxfam uses music as a way to cross cultural and language barriers. Most recently, Blur lead singer and co-creator of the Gorillaz, Damon Albarn, travelled to Mali to play with local musicians, bringing the creative output of his travels back to the UK to complete the cultural exchange.

The cohesive potential of music is increasingly wielded to tackle problems of social exclusion. Low esteem stemming from past educational failure or unemployment often lies at the heart of social exclusion. Creating music can build self esteem by allowing individuals to learn new skills – breaking the link with past failure. Soft learning through music can build the confidence needed to play a more active role in society. Music can be a particularly effective tool to tackle disaffection among young people since they have a particular affinity with music. An HIV/AIDS project in the USA uses hip-hop to breakdown barriers with African American young people (Stephens, 1998).

Participation has traditionally been at the heart of music. Creating music and listening to music were both group activities. It is only recently that music has become a more solitary activity, with personal devices making music an individual pastime. But the success of peer to peer networks for sharing music and the lasting popularity of live performance underline the ongoing social life of music.

4.3 The emergence of digital music

Digital music came to prominence with the launch of Napster, the illegal file sharing service. At the height of its popularity in summer 2000, estimates suggest that 67m registered users were illegally swapping music files on Napster (Ref). The Recording Industry Association of America (RIAA) launched legal proceedings against, and eventually shut down, Napster, but new illegal services have sprung up in its place, such as Gnutella, KaZaA, Limewire and Bearshare.

The recording industry has taken a multi-pronged approach to the piracy of digital music and illegal file sharing services from the outset. It has sought to create a viable alternative to the illegal services by launching its own legal music services, Pressplay and MusicNet in 2001, and by licensing content to independent services such as OD2, Europe's largest online music provider. In doing so, it has faced several hurdles. It has been difficult to get agreement from some artists to license their material in digital format, and to get different recording companies to license their catalogue to the same service. Above all, it has been a challenge to compete against a free service. But the industry is committed to making music "easier to buy than to steal". Recording companies are increasingly licensing content to a wide range of services to ensure that it is as easy as possible for consumers to get their hands on legally downloaded music.

At the same time, the recording industry has continued to pursue illegal services through the courts and is developing technological solutions to enforce copyright, supported by a new legal framework. The EU Copyright Directive which should come into force in national law in 2003 prohibits the circumvention of copy protection systems, whilst seeking to protect those public interest exceptions already recognised in copyright law. The industry is also wielding the persuasive appeal of its artists in awareness-raising campaigns about the value of copyright. The first campaign was launched in the US on 26th September 2002, supported by Madonna, Elton John and Britney Spears, among many others.

Legally purchased digital music still represents a tiny fraction of the music market. In 2000, it accounted for a mere 0.5 per cent of online music. By 2006, online music sales in Europe are expected to reach 2.3bn euro. This represents only 15 per cent of the total regional market (Sinnreich & Mulligan, 2001). But more music is being listened to than ever before. In 2001, 9.3 billion tracks were acquired every month in contrast to 5.9 billion in 1996 (Rose, 2002). There are now more than 900 million music files available for download free on the internet (Financial Times, 15th November 2002). Socially speaking, music is flourishing. But almost all of the music consumed digitally is illegally downloaded.

The internet represents only one distribution channel for music and will remain so into the future. But the growth of digital piracy has already challenged established thinking. From the pianola to the CD, new waves of technology have always altered the context in which music is listened to, creating new challenges and presenting new opportunities for the recording industry and for society. Digital distribution is no different but there are two features of digital technology that make it particularly disruptive. Firstly, infinite copies of a digital file can be made at the click of a mouse without diminishing the quality of each copy. The ease of making perfect copies differentiates digital files from tapes and CDs. Secondly, digital technology significantly lowers the barriers to entry for the production and distribution of music. A home computer equipped with the right software can produce reasonable recordings and the internet provides a vehicle for the global distribution of digital files at almost no cost.

The ease of copying and distributing digital files is presenting the recording industry with a huge challenge. But it should not ignore the social life of music. It depends on society for the raw creativity on which it can build a future. It is, therefore, in its interests to respond to the changes brought about by digital technology in a way that minimises social risks and maximises social opportunities. Social innovation needs to accompany business innovation.

This case study will focus on four key areas where the development of digital music is changing the social impacts of the recording industry. Discussion in each area will highlight social risks and opportunities over which the industry can have some influence. The first section, access to music, argues that digital music is unlikely to increase access to music as long as access to music is dependent on access to a personal computer. However, there is an opportunity for the popular appeal of music to motivate people online. Section two focuses on new opportunities for creativity in the digital sphere, but warns that creativity could be undermined by illegal downloading and argues for proactive engagement between all stakeholders on copyright issues. Section three highlights opportunities for greater diversity of music from across the world in the digital domain. At the same time, it questions whether diverse talent will get heard among the cacophony of the internet. In section four, discussion highlights contradictory trends – the internet promotes participation through online communities but may also exacerbate social isolation as children retreat behind computer screens. In the concluding section, the focus shifts to the music industry. The case study proposes steps that could be taken to tip the balance in favour of the social opportunities rather than any social risks stemming from digital music.

4.4 Access to music

Gramophones took professional performance from concert halls into people's homes. Radio significantly widened individual access to music, as did audio tape technology by making music recordable and portable. But digital music is unlikely to increase the number of people who have access to music for the simple reason that it depends on access to the internet which, for most people in Europe, still means access to a personal computer (PC).

PC access and access to the internet have increased dramatically in Europe since 2000 when EU governments committed to getting Europe's citizens online as part of the eEurope Action Plan. Nevertheless, patterns of digital inclusion continue to mirror patterns of social inclusion, leaving low income earners, the unemployed, disabled, elderly and those living in Europe's poorer regions unable to afford access or without the necessary skills, confidence and motivation to get online. For example, people under 35 were one and a half times more likely to access the internet as over 35s in 2001 in Germany and Italy and more than twice as likely in France. In the UK, Italy, Germany and France, people earning over 55,000 euro a year were between one and a half and two times as likely to have access to the internet as those earning less than 55,000 euro a year (Booz Allen Hamilton, 2002). Yet the unemployed, low-income earners, the disabled and elderly are the very groups who could benefit most from the wider potential of music to foster social integration through greater self expression and confidence. Public internet access in libraries or internet cafes is inadequate for listening to music. The technology is often outdated. Downloaded files cannot be stored on the hard drive of public computers, and it may not be possible to listen to streaming content in a public space.

It can take up to 4 hours to download an album using a standard 56k modem. The same album takes only 15 minutes to download with broadband (Digital Subscriber Line)[43]. It is no coincidence that illegal downloading first took off in universities where young people have free access to a high speed connection. The take up of broadband has gathered speed in the last year, but remains a relative luxury, with 72 per cent of households with internet access in the EU continuing to rely on a standard dial-up connection (Eurobarometer, 2002). In many cases, confusion over what broadband actually is and low perceived value of the internet itself are the barriers to access rather than absolute cost.

The development of alternative internet access platforms to the PC may in the future provide wider access to digital music. Mobile phone penetration in Europe is currently 70 per cent,

[43] Calculation carried out by the Wuppertal Institute for the Digital Europe project.

and as high as 80 per cent in the UK and 97 per cent in Luxembourg. More significantly, mobile phone ownership cuts across socio-economic divides far more than internet access. In 2001, the penetration of mobile phones among socially excluded groups in the UK[44] was 55 per cent compared to 66 per cent in the population as a whole, against 22 per cent and 40 per cent for the internet (Department for Education and Skills, 2001). But mobile as an alternative internet access device for the majority population is a medium term solution. Even if Third Generation technology does deliver high quality access to the internet via mobile phone, services will initially be priced at premium rates and will be targeted at high revenue customers. Digital television may hold the key to widespread access to digital music. Penetration is currently low with the UK taking the lead with 40 per cent of households having a digital television (Booz Allen Hamilton, 2002). But, interestingly, penetration is as high as 32 per cent among the socially excluded. (Department for Education and Skills, 2001).

The International Federation of the Phonographic Industry (IFPI) reacted angrily to the announcement in September 2002 that KazaA, an illegal file sharing service, was to advertise on the pages of the internet service provider (ISP), Tiscali. Tiscali figured that it could drive take up of its broadband service through the downloading of music. Increased take up of broadband represents a challenge to the recording industry since it facilitates digital piracy. But it is important not to overlook the opportunity for music to play a part in getting Europe's citizens online in the broadband environment.

The availability of relevant online content is a key driver of internet access and research indicates that there is still a shortage of content to motivate disadvantaged groups online. A study by The Children's Partnership in the US identified four content-related barriers to getting disadvantaged communities online. There is a real lack of relevant, particularly local, information and very limited cultural diversity in the content available. Although less than 50 per cent of information on the web is now in English, the information located by search engines continues to be predominantly in English and tends to be designed for an audience with average or advanced literacy skills (The Children's Partnership, 2001). The relevance of music to many people's lives could make it an effective driver of online activity, particularly among young people.

As the integration of digital technologies into our economic and social lives continues, the greater the likelihood that not having access to the internet will exacerbate social exclusion. Studies have demonstrated the importance of social networks, particularly networks extending beyond family and neighbours, for the creation of economic and social opportunities such as jobs. In his paper, "Escaping Poverty", researcher Perri 6 argues that a helpful way of understanding social exclusion is network poverty.

> *"The network poor are individuals who do not have the kind of social network configuration that is most appropriate for the stage of the life course they have reached, to enable them to thrive" (Perri 6, 1997)*

The internet and mobile phones can open doors to new "networks of opportunity" and can be important in maintaining existing social networks. Over time, accessing social networks in the developed world, and the life chances they offer, will become more reliant on the ability to access and use technology. The imperative to motivate people to be active users of the internet remains strong.

---

[44] Socially excluded here refers to socio-economic groups DE and E, individuals with low literacy, the homeless and individuals in deprived areas

The digital divide is no longer the sole concern of the telecoms sector and ISPs. As other sectors such as banking and retail develop internet-based services, they have an interest and a responsibility to create an inclusive Information Society. The recording industry could make a significant contribution to digital inclusion. If it is to do so, inclusion must remain a consideration in the development of the industry in the digital age.

4.5 New opportunities for creativity

Digital technologies are tearing down barriers to musical creativity. Software can help even the least talented find self-expression through music. To record music, you can now make do with a home computer where you would once have needed a recording studio. And if you want to share your creativity with others, the internet does not discriminate: it is a free space, a "creative commons", where any creation can seek out an audience anywhere in the world at almost no cost. According to the US technology commentator, Clay Shirky, what we are witnessing is mass amateurisation made possible by technology. Shirky writes about the explosion of individual publishing through the use of weblogs – "a platform for the unlimited reproduction and distribution of the written word, for a low and fixed cost. No barriers to entry, no economies of scale, no limits on supply" (Shirky 2002). The same is true of music. Of course, there are no guarantees of being heard. But, for many people, self expression and fulfilment comes from sharing their creativity with friends and family. If others chance upon it, more the better.

Creating music can be an important way to reintegrate people into a learning environment by building self confidence. For individuals with limited literacy, multimedia content, including pictures and sound, can be an effective means of breaking down the barriers to learning created by word-based materials and methods. Couple music with technology and new opportunities emerge to build self confidence and give people access to valuable skills for today's economy - creativity, content development and multimedia literacy (Shearman, 2000). For example, the Young People's Centre in Brighton and Hove in the UK works with 13 to 25 year olds at risk of exclusion. The Centre aims to enable young people with low educational attainment to re-engage with learning through ICT. Much of this learning takes place through the creation of music, with the young people able to produce their own CD to take home[45]. The benefits of such initiatives often go beyond the individuals involved; the self-esteem of entire communities can be boosted. In this way, participation in musical creativity can promote more effective participation in wider society.

The creative potential of digital technologies can be a spur to professionals as much as to amateurs. Techno-visionary musician, Peter Gabriel, argues that technology opens up new vistas in music-making. "The ease with which you can try ideas is fantastic. When I started, music was what you could achieve and generate yourself. I think today it's more about what you can conceive, and that makes the possibilities endless" (Guardian, 19th September, 2002). Travelling the world with a lap top as a digital recording studio, the band, 1 Giant Leap, collaborated with musicians, authors, scientists and thinkers across the world in order to explore "unity in diversity". Band member Jamie Catto echoes Gabriel's sentiment, arguing that digital technology offers less established musicians greater opportunity to try out new things: "The technology makes the creative pre and post production process much cheaper,

[45] Information provided by PACT, Brighton and Hove

opening all sorts of inspiring doors to those who wouldn't otherwise get a chance to work, experiment, immerse themselves" (Interview with Forum for the Future).

As digital technology extends creative possibilities, so it provides opportunities via the internet for new talent in particular to get their music heard outside of live performances. Sites such as www.peoplesound.com and www.iuma.com promote new and alternative talent. In some cases, they act as talent scouts for the major record labels; in others, they feature artists that are unlikely to be promoted by mainstream labels. The set up costs of a commercial digital music service can be high given extensive investment in technology. But the marginal cost of storing digital files is low. This allows web-based services to provide unknown artists with an invaluable channel to market. A CD need only be burnt when a sale is made. The incentive to create music can be greater if up and coming artists have a chance of getting their music heard.

There are opportunities to promote creativity at all levels through digital technologies – from the music loving amateur to the established artists. But digital music could be a mixed blessing for musical creativity if high levels of piracy persist. Many top selling albums are available on file sharing networks before they have been officially released. The risk is that the illegal downloading of music will undermine the ability of artists and producers to earn adequate reward from their creative talents, and the ability of the recording industry to invest in new talent. It costs on average 400,000 euro to produce an album for a new artist, a further 80,000 euro to 320,000 euro to produce the accompanying video and then there are marketing costs to consider. Nine times out of ten the costs are not recouped but big successes fund up front investment in new talent. If the industry is facing reduced sales caused by piracy, it may not have sufficient resource to invest in new, diverse talent and build catalogue for the future.

Starting with the Statute of Anne in 1710, copyright has been developed over the last three hundred years as a compromise: a time-limited, state-secured monopoly for creators of original work in return for enrichment of the public domain at a later date. This compromise is under threat. Peer to peer music sharers are resisting any restrictions on what they can do with other people's content and digital technology gives them the perfect weapon. A music file can be copied and distributed globally in seconds. Unable to control their rights through the law, rights holders, including the music industry, are searching for greater control through the use of technology. But there are concerns that the control achieved through copy protection mechanisms and digital rights management will go further than the compromise underpinning copyright ever intended. For example, Adobe's Ebook Reader can be set up prevent users making copies of content from books that are already in the public domain.

If copyright is not to be fatally eroded as a legal construct in the digital age, there is a need to build understanding of its aims and value among all stakeholders – business, government and the public. It's too early to know what the longer term impacts of a breakdown in the compromise will be on the health of Europe's creative industries and cultures. But the risk itself necessitates action to protect Europe's rich cultural capital.

4.6 Promoting diversity

The internet houses a far greater diversity of music than any one high street record shop or even the likes of Amazon could possibly manage. Since music can now be stored as digital files, hardware memory can replace warehouse space. In the past, the high cost of manufacturing, distributing and storing CDs created high barriers to entry. Digital distribution lowers barriers to entry, opening doors to musical diversity.

Diversity in all spheres acts as a spur to creativity. For example, research from the Brookings Institute in the US indicates that the most successful cities in the high-tech economy also have the most diverse populations (Florida & Gates, 2001). Business thinker John Kao argues that creativity increases exponentially with the diversity and divergence of those connected to a network (Kao, 1996). In music, diversity has consistently been at the root of creativity, as musical genres borrow from each other to create new sounds.

Cyberspace is shedding its Anglo-American bias to become a truly global space. There are over 1,500 languages now on the internet and over 50 per cent of online content is not in English. As linguist David Crystal says, "the internet has a glorious multilingual future ahead of it". The internet offers global channels of expression to local cultures. Music is a medium for communicating shared values and the historical legacy of a community. For minority and endangered cultures, the ability to communicate their music on a global scale may represent the chance of cultural survival. This has certainly been the case for minority languages. For example, there are now hundreds of sites in Welsh as well as Welsh chat rooms. Virtual speech communities have sprung up allowing people to converse in their own language in a way inconceivable just a decade ago. For many years, UNESCO has painstakingly collected samples of indigenous music as a record of the world's cultures. But this is a historical repository. The internet can actually breathe new life into minority cultures.

Music is a powerful bonding force. But it can equally cross borders, communicating between communities. As such, wider distribution of local music could provide a human face to globalisation, promoting greater cultural understanding. This may go some way to mitigating the backlash against the growing dominance of English and the widespread diffusion of symbols of western, primarily American, culture that are stoking fears of cultural globalisation - in the developing world but also in countries such as France.

This positive prognosis is challenged by Jeremy Rifkin, author of the influential book, *The Age of Access.* He voices concern that the global communication of culture could impoverish cultural capital. He cites the example of raï music from Algeria which originated in the cabarets of Oran and grew out of economic and political unrest. But its deeper political message was lost when it hit the mainstream market. The 1998 World Culture Report from UNESCO highlights the problem of cultural commodification, saying of raï music, "while raï music has been transformed in the international context, its capacity to act as a vehicle for expressing the concerns of an anti-establishment constituency in Algeria is threatened" (Rifkin, 2000). In making music accessible and appealing to the mainstream market, it can often become removed from its cultural heritage. While this can be musically innovative and bring local music to new audiences, its repercussions for local communities can be more mixed.

Record companies such as EMI see the promotion of musical and cultural diversity as a key part of their role:

"Our artists' music is key to maintaining the cultural identities of communities throughout the world, and one of our roles as a business is to develop repertoire that comes from local cultures. But another business objective is to spread that music to other countries. In this way, we promote artists who otherwise wouldn't have access to world markets and play an important role in promoting cultural diversity in the communities in which we operate" (EMI Environment and Community Report, 2002)

EMI recognises and is excited by the new possibilities that digital distribution offers for the promotion of diversity and hopes to use digital technology to better serve diverse musical interests. For example, it has traditionally been difficult for immigrants to get easy access to music from their home countries while living abroad. The demand for Macedonian music in the UK is unlikely to be high enough for high street shops to stock a single CD. But, on the internet, record companies are better placed to cater for any culture or taste anywhere in the world.

But who actually gets heard among the cacophony of the internet? There is rightly scepticism about whether the internet will really allow a more diverse mix of musicians to make a living from their creative talents. As former US Labor Secretary Robert Reich comments with respect to the musician, Todd Rundgren: “Rundgren didn’t start his career on the internet, and his innovative music hasn’t attracted many fans there directly. Before he launched himself into cyberspace he had already built a following” (Reich, 2001). We are far more likely to purchase well known artists who are supported by the promotional expertise of a major record label than an unknown. 31 percent of downloaders may have downloaded music from an unknown artist, but 86 per cent download music they have already heard before and 69 per cent search for music by artists they are already familiar with (Graziano, 2001). The internet is a confusing, noisy place. We rely on trusted sources to act as a filtering mechanism and provide us with digestible information. Global artists of the likes of Madonna and Moby will be as persuasive online as in the physical world. New, diverse sounds could struggle to get heard. Over time, our willingness to experiment is likely to increase as we become more familiar with the online environment and new forms of sign posting develop. For example, message boards on websites such as HMV.com and Pressplay rely on user comments to alerts others to content they would like.

4.7 New forms of participation

In his latest book, *Up the Down Escalator,* leading new economy commentator Charles Leadbeater recounts how, when he was a child, listening to music was a family activity.

“When my father bought our first ‘stereo system’ …it too came in brown wood and it sat on top of a wooden cabinet that stored his large LP collection…. Music was not portable and personal: we listened to music in a particular room in the house at set times in the evening” (Leadbeater, 2002).

Today, it is far easier to satisfy your own musical preferences. Walkmans, MP3 players, mobile phones – however you choose to listen to music, it is increasingly a private activity as devices become personal and portable. In his seminal work on social capital in the United States, *Bowling Alone,* Harvard Professor Robert Putnam argues that the privatisation of leisure time driven by television has significantly reduced community participation in the US.

This trend could be further aggravated by the growth of digital music, isolating children, in particular, behind computer screens. Even the physical interaction needed to share a new tape or CD with a friend is no longer essential. A digital file flies round the world at the click of a mouse. Words may be exchanged in an accompanying email but there is no need to actually meet. Even the creation of music itself can now take place asynchronously – with one artist in Europe and the other across the Atlantic. Many children already spend a significant amount of time at a computer doing homework, playing games and communicating electronically. Growing fear of public space among parents has led to growth in indoor leisure activities among children (Ref). But leisure time is limited. More time spent at a computer could force physical activities and social interaction off the agenda with adverse consequences for the health and emotional intelligence of the next generation. The risk is that we are creating a generation of children who are "new media" savvy but passive and socially illiterate.

Putnam's despair is directed primarily at television. In *Bowling Alone,* he is less sure about the impacts of the internet and suggests that it could promote an active rather than an passive society.

"Let us find ways to ensure that by 2010 Americans will spend less leisure time sitting passively alone in front of glowing screens and more time in active connection with our fellow citizens. Let us foster new forms of electronic entertainment and communication that reinforce community engagement rather than forestalling it" (Putnam, 2000)

Interactivity has traditionally been at the heart of musical creativity. Conductor, performer, dancer, audience – each responds to the other. Moving from broadcast media such as radio and television to the internet, we are regaining some of the interactivity inherent in traditional musical creativity.

The internet has stimulated the development of online communities of interest around every conceivable issue. Music is no exception. There are online communities for everything from Brahms to blues. Communities of music fans are nothing new. However, global interactivity has been made infinitely more possible by the internet. For example, BhangraOmega.com is a website that gives fans all the latest information from the world of bhangra music as well as opportunities to discuss everything from music to arranged marriage with other fans. Artists are exploiting the internet to reach their fans directly and involve them in the creative process. Several established artists such as David Bowie are releasing samples of new work on the internet and encouraging feedback from fans. The group, Ash, used the internet to involve fans directly in the selection of the B side for a recent release.

Online communities thrive through a shared sense of identity. Music, and the personalities associated with it, have long provided fans with a sense of identity and belonging. The ability to communicate and share with other fans can enhance the ability of music to create a sense of identity and belonging for many individuals.

Sceptics have dismissed online community as a poor reflection of traditional community, lacking the social support provided by physical interaction. In part, this plays on a rose-tinted view of place-based community. In reality, tightly knit communities can be introspective and hostile to outsiders (Harris, 2002). More importantly, online communities rarely exist in isolation from other social networks. Research suggests that email and the internet do not replace face-to-face contact and the telephone, but are supplementary. They allow individuals to maintain diverse social networks, but not necessarily at the expense of neighbourhood ties (Wellman, 2002).

In fact, as the internet becomes a mass market phenomenon with over 50 per cent of the population online, online communities are increasingly supporting local community. Go online today and someone else in the same neighbourhood, even in the same street, could well be online. This is a far cry from five years ago when you were more likely to meet someone from the other side of the world online than from down the road. Websites such as www.meetup.com facilitate local meetings of interest groups, acknowledging the social potential of the internet in promoting local interaction. If the internet continues to develop in this way, there is an opportunity to buck the trend of social isolation envisaged in a digital dystopia, and music could play an important role in bringing people together virtually as it has long done in the real world.

4.8 Conclusion: Corporate social innovation

Digital technology has disrupted business as usual in the recording industry. At the same time, it is reshaping the social life of music, creating new risks and opportunities around access to music, creativity, diversity and social participation. The recording industry has an important role to play in harnessing the social potential of digital music.

In some ways, the recording industry is more fortunate than other industries. Its basic product provides people with pleasure and entertainment. In doing its job well, it "automatically has a tangible social value" (EMI Environment and Community Report, 2002). In addition, recording companies invest in the communities in which they operate, targeting music education, music therapy and community music in particular. For example, EMI set up and continues to support the Music Sound Foundation, an independent UK-based charity that helps to make all kinds of music education available in different learning environments. The recording industry is the main sponsor of Nordoff Robbins, the leading music therapy charity, and of the Brit Trust, which supports the Brit School for Performing Arts and Technology. The industry also contributes significantly to many other community and educational music projects.

But, the recording industry, and the music industry in general, has tremendous potential some of which is currently going unused. If we are to build a more sustainable society, we need to do things differently – to be creative, to innovate. Creativity is the life blood of the music industry. It can harness this creativity for positive social change and align social responsibility with business innovation. Long before pamphlets and political tracts, song was a vehicle for social commentary. As Julia Cleverdon, Chief Executive of Business in the Community, has noted, the music industry is well placed to make a significant contribution to tackling some of today's tough social issues such as drug abuse and deprivation (EMI Environment and Community Report, 2002). Similarly, music is a powerful communicator and the industry, particularly the artist community, is adept at communicating and influencing audiences. Its marketing skill can equally be a powerful social tool. To people outside the music industry, it is an exciting, glamorous world. It is exactly this popular appeal that puts the industry in a position to make an important contribution to sustainability.

Sustainable development is the process by which we move towards sustainability - economically, environmentally and socially. At Forum for the Future, we define sustainable development as:

"A dynamic process which enables all people to realise their potential and improve their quality of life in ways which simultaneously protect and enhance the Earth's life support systems."

In light of the new social risks and opportunities created by digital music, this would be a good moment for the music industry to take stock of its approach to social responsibility and evaluate the ongoing relevance of current priorities. Importantly, the emergence of digital music also presents the industry with a renewed rationale for integrating social opportunities into the heart of the business.

In the past, the music industry has not been consumer facing, relying on artists to communicate with the public. Artists remain a strong brand but the industry is having to become more consumer facing in the digital age. High profile law suits and digital piracy have brought the industry into the public eye but have also tarnished its reputation. A recent paper by researchers at Microsoft concludes, “There will be short-term impediments to the effectiveness of the darknet (file-sharing networks) as a distribution mechanism, but ultimately the darknet-genie will not be put back into the bottle” (Biddle et al, 2002). This conclusion is echoed by technology commentator, John Naughton when he says, “There aren’t enough lawyers in the world to stamp out file-sharing” (Observer, 1st December 2002). Investment in digital rights management and support for new legislative measures will not be enough to ensure the success of legal music services. Rebuilding trust and reputation with the public also has an important role to play in making consumers think differently about piracy and the value of creativity.

But how does the music industry build trust? In a survey conducted in 2002, the Co-operative Bank, an ethical bank with a strong commitment to environmental and social responsibility, was voted the most trusted company (MacGillivray, 2002). Evidence of the link between corporate social responsibility and trust is growing. Social responsibility already sits at the heart of business in some music companies, but an industry wide approach to social responsibility would send a strong, unified signal to the public, making consumers more receptive to awareness-raising on digital piracy. Different, at times conflicting, messages can make it difficult for the public to know whom or what to trust. For this reason, industry wide commitments to social responsibility have been adopted by other sectors seeking to build trust and reputation with the public, for example the telecoms industry has created the Global eSustainability Initiative to pursue a global, industry-wide sustainability agenda.

5. Future Trends

Based on sector specific insights gained from the case study, as well as on literature and internet sources, trends and future developments in the music sector have been identified. These trends have been classified according to their predictability and linked to environmental and social effects, both risks and opportunities.

We first look at three technical, infrastructure related trends which will have effects across different sectors. We then go on to examine three sector specific trends. Each trend is of relevance to the music sector, but they are by no means exclusive. In each case, a short description of the trend is followed by a description of possible environmental and social consequences. Figure 5-1 at the end of the chapter summarises the trends and their effects.

5.1.1 Penetration of Broadband Infrastructure Increases

Broadband connectivity can be defined as an internet connection with a capacity of at least 256 Kbps downstream and 64 Kbps upstream. Today, this speed can be reached with DSL, cable modem, satellite and powerline connections. In OECD countries, the percentage of people with access to broadband infrastructure doubled between January 2001 and June 2001. About six per cent of EU homes now have broadband internet access[46]. Competition between infrastructure providers is also increasing. While cable access is likely to dominate in the US (51 per cent share of the broadband market), in Europe DSL looks likely to take the lead. Future predictions suggest that DSL will account for 51 per cent of the broadband market in Europe.[47] Options for wireless broadband access are described in the Mobile internet section.

Representatives from the music industry are convinced that digital music, or more precisely peer-to-peer file sharing, is contributing to the growing penetration of broadband connections. On the surface, high speed internet access cuts down on delivery times, making downloading music an attractive and environmentally beneficial proposition in contrast to slower download speeds. However, the large number of (illegally) downloaded music files currently represents some additional consumption rather than substituting fully for music purchased on CD. If the music industry succeeds in shifting the demand for downloaded music from illegal downloads to legal consumption models, and if this results in a reduction in the number of pre-recorded CDs sold, resource consumption may shrink. But if there is no substitution for CDs, resource savings are unlikely.

But resource savings through substitution are likely to be offset by growth in the number of dedicated internet lines where users have no incentive to disconnect from the network. Broadband connections will make the internet a central part of our every day lives, from communications to (financial) transactions to entertainment. Given that fast, cheap (flat rate) internet connections are required for the digital delivery of music, broadband internet access can be seen as a prerequisite for mass market penetration. According to EITO: "broadband services such as DSL, cable and fixed wireless access with substantially higher bandwidth and lower latency are essential for rich media applications such as video/music (both

[46] European Information Technology Observatory. (2002): European Information Technology Observatory 2002, p. 15.

[47] For this and more numbers on broadband internet access consult NFO Infratest (Germany) (2002): Monitoring Informationswirtschaft – 4. Faktenbericht 2002, p. 110-143.

streaming and file download), or online gaming[48]". An environmental benefit is that digital delivery equates to made to order production, avoiding unwanted stock and product returns. On the other side, it encourages bulk downloading (and/or streaming), calling into question the environmental gain from digital music.

In the short term, broadband is unlikely to widen access to music. Despite falling prices, it remains relatively expensive. However, music may be a way to stimulate greater use of the internet. Studies show that usage rather than simply access is key to realising the social benefits of online access. If the price of broadband access falls significantly in the medium term, it is likely to stimulate wider take up of digital music which, in turn, may promote internet use.

5.1.2 Mobile Internet

Laptops and small handheld computers increasingly have fast wireless network access and mobile phones are expanding their computing capabilities and range of applications ("smart-phones"). We seem to be moving towards a future where devices provide wireless, mobile, full-scale internet access. In 2000, Lucent Technology claimed that "the mobile terminal will, in fact, replace the computer as the most frequently used device to go online", offering opportunities for new services and revenue creation.[49] Three years on, there is still a lack of infrastructure, new devices and services, and "because of this 'chicken and egg' conundrum, the mobile internet is potentially the biggest gamble the telecommunication industry has ever taken on."[50] This is compounded by the fact that network providers paid enormous sums for third generation licences, amounting to 100 billion USD on a global scale.[51] EITO states that "throughout 2001, the market for mobile internet services remained largely untapped despite huge investments in new wireless technologies. […] It is estimated that revenue from mobile internet-related services will grow from about € 9.8 billion in 2001 to over € 75 billion in 2006 and increase their share of the total mobile services market from 8 per cent in 2001 to 47 per cent in 2006. Data traffic statistics suggest that usage per mobile internet customer is growing, indicating growing acceptance of mobile internet services.[52]"

There are two camps in the debate around device convergence. One believes in convergence and foresees the death of pure phones and pure Personal Digital Assistants (PDAs). The other sees smart-phones as proof of the ongoing proliferation of new device types and the trend towards users having more and more devices with overlapping functions.[53] The view that "devices are best if they follow their primary functions"[54] competes with the vision that performing different tasks with one mobile device will offer more convenient, cheaper and easier services.

---

[48] European Information Technology Observatory. (2002): European Information Technology Observatory 2002, p. 49.

[49] Lucent Technologies (2000): Changing Times – Next Generation Mobile Data Trends, Lucent Technologies, Bell Labs Innovation, Brochure Number WPNGMTREND 05/00, p. 3.

[50] ITU (2002): Policy and Strategy trends: internet for a Mobile Generation, ITU Strategy and Policy Unit, International Telecommunication Union, p. 1.

[51] ITU (2002), p. 1

[52] European Information Technology Observatory. (2002): European Information Technology Observatory 2002, p. 190.

[53] Synchrologic: The CIO Wireless Resource Book – Information and analysis to assist with planning for wireless computing, 1-888-345-SYNC (7962), p. 19.

[54] Michael Gartenberg (2002): Conversation Trumps Convergence, August 26, 2002. [Online] Available: http://www.computerworld.com/mobiletopics/mobile/story/0,10801,73724,00.html [2002, November 19].

Network infrastructure relies on new standards offering broadband access to internet content. The emerging standard for third generation telephony (3G) is UMTS, with other standards, e.g. GPRS, competing. High connection rates via UMTS won't be reached in the introductory phase of UMTS, which may inhibit roll out.[55] Opportunities with 3G include "location based services", Multimedia Messaging Service and the downloading of music.

Like all internet applications, mobile internet relies on ICT infrastructure that needs to be built, run and maintained. However, it appears unlikely that mobile music applications will have a significant impact on the infrastructure as a whole, nor are mobile applications in the music sector expected to have significant environmental effects in the near future. Effects related to portability are discussed in section 5.1.4.

In the short term, mobile internet services will be priced at premium rates and will be targeted at higher income earners. For these customers, mobile access will increase flexibility and choice over when and where they consume music. But this level of flexibility and choice will not be widespread in the short term. Over time, mobile internet access could allow people to exchange music in the way that they currently exchange text and picture messages.

5.1.3 Internet Access via TV

The coming together of internet and television technologies is widely discussed. Advantages include high levels of TV penetration across Europe and the high speed capacity of cable connections. Prognoses go so far as to expect integrated digital TV to overtake PCs as the main gateway to the internet in Europe by 2005[56]. However, the digitisation of cable networks and the existence of set top boxes and display systems, all prerequisites for the take off of digital TV, have reached different levels in different European countries. For example, Germany is lagging behind, with the biggest provider "Premiere World" not gaining a real foothold in the market. In contrast, the UK and France have highly successful digital providers that offer additional interactive content.[57] As internet access is already widespread, success will depend on the development of content combining web- and TV-typical characteristics.

Comparing internet access via TV and PC, we need to distinguish between mirco and macro levels. At the micro level, there are unlikely to be significant differences in material intensity, but this may not be the case at the national or international level. Internet applications delivered via TV will open up e-markets to new sections of the population. As long as the digital delivery of music substitutes materially intense physical retail, environmental savings will be made. But the likelihood of this happening remains unknown.

Digital television has the potential to significantly increase access to digital music. Almost 99 per cent of households in Europe have a television set and TV ownership cuts across socio-economic boundaries. But this depends on widespread take up of the service.

[55] NFO Infratest (Germany) (2002): Monitoring Informationswirtschaft – 4. Faktenbericht 2002, p. 174.

[56] Bundesministerium für Wirtschaft und Technologie [German Federal Ministry fo Economics and Technology]. (2001). Monitoring Informationswirtschaft [Monitoring Information Economics] – study by Infratest Burke GmbH & Co. and the Institute for Information Economics. Berlin: BMWi, p. 5.

[57] NFO Infratest (Germany) (2002): Monitoring Informationswirtschaft – 4. Faktenbericht 2002, p. 140.

5.1.4 Increasing Portability

Music is increasingly portable and can be transferred from one device to another. For example, high capacity memory cards carrying data such as documents, presentations and music files can be loaded on to any device via a USB (universal serial bus) port. USB ports allow high-speed data transfer, and are a standard feature on an increasing number of portable devices – for example a mobile phone with a USB and a headset becomes a mobile and personal stereo.

In the near future, almost all handheld computers will contain music players, and there will be plenty of ways to move data from a PC to a handheld. The spread of wireless network access (e.g. UMTS) in the future will make further options available: You will be able to upload music files on to the internet and listen to them with any device without carrying memory cards around. This technique is pioneered by Live365.com, where you can listen to independent radio stations from a handheld computer using a wireless connection.[58]

The trend towards portability is likely to speed up the shift towards compressed digital music. Since more and more devices (such as PDAs, mobile phones etc.) will have music players, there will be less need for dedicated equipment. The case study has shown that digitally distributed music has lower material intensity than a CD, assuming that a broadband connection is used and taking into account only 8 per cent of the impact of the CD-R in the case where music is burnt onto a CD-R. If we assume that compressed files will replace CDs at an increasing rate, portability could help to decouple music from resource consumption. In addition, the fact that music files will be transferred from one device to the next will make resource intense music streams less attractive. Yet, increasing usage of digital music will lead to higher demand, resulting in more downloads and possibly higher overall resource intensity.

Increasing portability will increase flexibility and choice for many customers. The price of memory has fallen dramatically in recent years, making portable memory within the reach of most consumers within the next three to five years.

5.1.5 Market share of CDs decreases

To investigate this trend, two critical questions have to be answered: What is the trend in CDs sales, and how will the rest of the music market develop.

The first trend is quite clear. The 2002 RIAA mid-year statistics show declining numbers both in volume and value in all material sales formats, except DVD and Vinyl LPs, with the sharpest decrease in CD Singles. Shipment of standard CDs fell by 7.2 per cent in volume and 5.1 per cent in value[59]. Industry organisations like the RIAA claim piracy to be the main factor.

Estimating the future size of the overall music market is almost impossible, if piracy is excluded from the picture. The ability of legal online services and other innovative retail forms to compete with widespread piracy is uncertain. While some sources emphasise the threats[60], others stress great growth opportunities and increasing online subscription

[58] CNET Hardware (2002): Play music on your handheld. [Online] Available: http://computers.cnet.com/hardware/0-1087-8-5939469-2.html [2002, November 28].

[59] Recording Industry Association of America (2002): 2002 RIIA Mid-Year Statistics

[60] comScore Networks (2002): Press release – *Online Music Sales Declining Three Times Faster Than Overall Music Shipments, As File Sharing Applications Continue To Thrive*, November 04, 2002. [Online] Available: http://www.comscore.com/news/online_music_sales110402.htm [2002, December 03].

revenues.[61]

Modern peer-to-peer software makes it difficult for the music industry to fight internet piracy in the long term, and the industry will not be able to pursue every individual violation. Despite the industry's best efforts to raise awareness of artists' rights, it remains to be seen whether users will turn away from file sharing for ethical reasons. With the growth of flat-rate internet connections, it may be difficult for CDs to compete with file sharing services on price, and their market share may continue to fall.

The environmental effects of a shift towards digital distribution depend on a set of framework conditions. The substitution of digitally distributed music for CDs would represent an environmental gain. A study for the UK Department for Transport, Local Government and the Regions on the impact of ICT on travel and freight concludes, that "major developments in the music industry [… are just beginning and] that most commentators think [they] will lead to major changes in the distribution of musical products for sale. The bulk production of CDs and distribution from factory to retail outlet is expected to be largely replaced by online products and electronic distribution over the next few years[62]". In view of developments to date, it seems highly unlikely whether we will see such rapid development of digital distribution in the next three to five years. There is also the possibility that rebound effects will result in an increase in overall material consumption.

From an industry perspective, a decline in CD sales that is not matched by growth in legally purchased digital music could put the industry under financial pressure and undermine its ability to develop new creative talent.

From an individual perspective, a decrease in CD sales will have little social impact unless artists choose to release new work only in digital format. If this is the case then we could see the emergence of a two-tier entertainment system in which low income earners without access to the internet and broadband face limited choice.

5.1.6 Music Sold as Add-On

In the future, it is likely that one form of music sales to consumers will be as part of another service rather than as a separate commodity. For example, consumers would pay for a certain number of downloads as part of their monthly internet service subscription or mobile phone subscription. Tie-ups will be made between the music industry and a whole host of companies in the ICT, media and entertainment industries to deliver music to consumers.

Two opposing developments could stem from this trend. Music purchased as part of an all-inclusive offer, that is to say, as a by-product of other shopping or consumption activities (add-on), is unlikely to substitute for existing consumer (music) needs. Therefore, it would represent additional consumption that is not balanced by savings elsewhere. On the other hand, it could be argued that add-ons are a way of customising offers to relevant consumer groups. Taking the internet-based movie database as an example, users accessing the site to search for a movie are likely to be interested in the songs from the soundtrack as well. Offering songs for download may prevent the consumer from buying a full CD sound track when he is only interested in one song.

---

[61] Informa Media Group (2002): Music for Hire – Will Subscription boost online sales?, p. 7.

[62] Hop Associates. (2002): *The impact of Information and Communications Technologies on Travel and Freight Distribution Patterns: Reveiw and Assessment of Literature*. Final Report to the Departement for Transport, Local Government and the Regions, U.K., p. 33.

Bundling music as part of another service may limit access to digital music by increasing the cost of access. Rather than paying for individual downloads, customers may have to pay higher subscription charges.

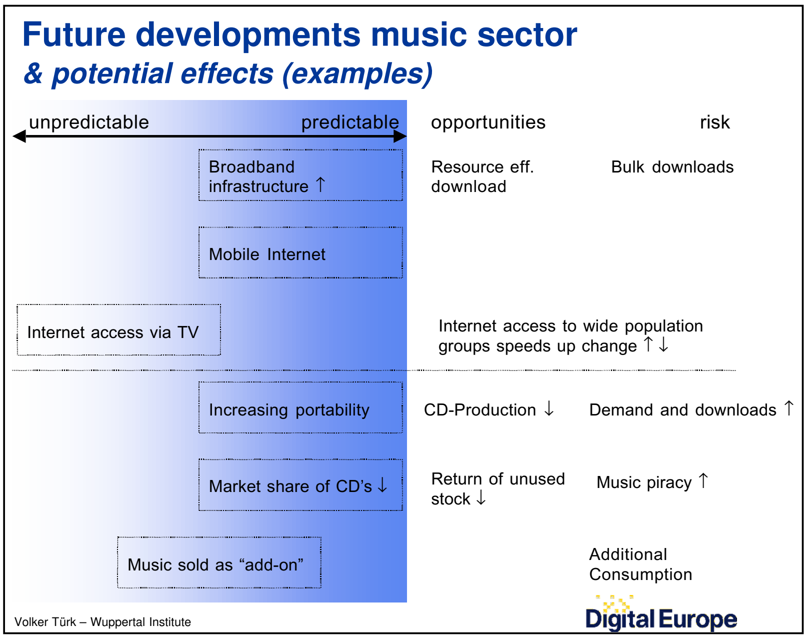

Figure 5-1: Summary overview of future scenarios in the music sector and some of their potential impacts.

6. Recommendations

Based on the case study findings, and taking future scenarios into consideration, the following recommendations are proposed in order to reduce the environmental impacts, in particular the material intensity, of the music sector, and capitalise on the social potential of digital music. Recommendations focus on the operational and strategic levels and are aimed at the music industry and government.

Operational level

In those scenarios in which a full CD is used as music storage medium, CD production turns out to be the largest contributor to overall material intensity. A closer look at the materials and resources used reveals that electricity consumption, followed by paper and plastic components are by far the biggest contributors. Despite the fact that EMI has progressively reduced the environmental impact of each CD, the production process should be analysed carefully in order to identify opportunities to improve eco-efficiency.

Focusing on material and resource inputs, it appears that electricity consumption or, more generally, energy consumption could be a focus area. Increasing energy (electricity) efficiency should continue to be a focus of EMI's environmental management system. Thorough investigation could help identify specific cost- and eco-efficiency measures.

A parallel strand of action could be electricity procurement. Research by the Wuppertal Institute concludes that, in general, renewable energies have a lower material intensity and are environmentally beneficial in comparison with non-renewable sources. A commentator in EMI's Environment and Community Report 2002 described EMI's early commitment to renewable energy at some sites as "seriously impressive"[63]. These early achievements need to be a trigger for further action in this area. Thus, criteria and incentives for a green(er), less material intensive power supply should be included into purchasing guidelines. As a complementary measure targets for continuously increasing the share of renewables could be set and reported against on a regular basis.

Managing eco-efficiency also means managing related cost issues. In this respect, the integration of environment cost accounting to existing management practices is an area for improvement. Material flow information can identify areas where there is significant potential for environmental improvements and cost reductions (see figure below), as compared to direct material inputs.

[63] EMI Group. (2002): *Environment & Community Summary Report 2002*. p.4.

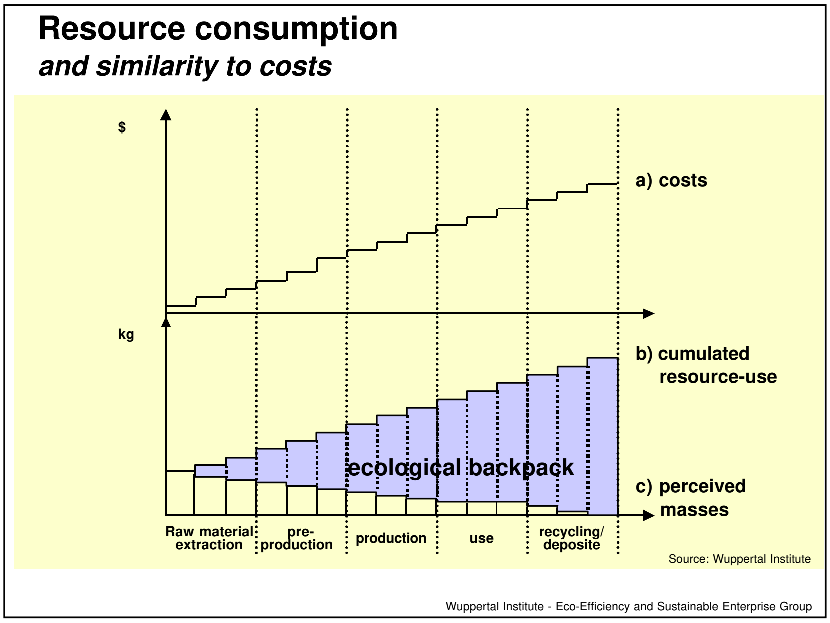

Figure 6-1: Similarity of costs and backpacks

An immediate response would be to combine economic information and material flow data. Economic information at the product level can often be taken from traditional cost accounting system, i.e. in the form of the cost price of the final product or its contribution margin. Further, the material intensity of processes can be allocated to the products with the aid of company material accounting, as shown in the figure below.

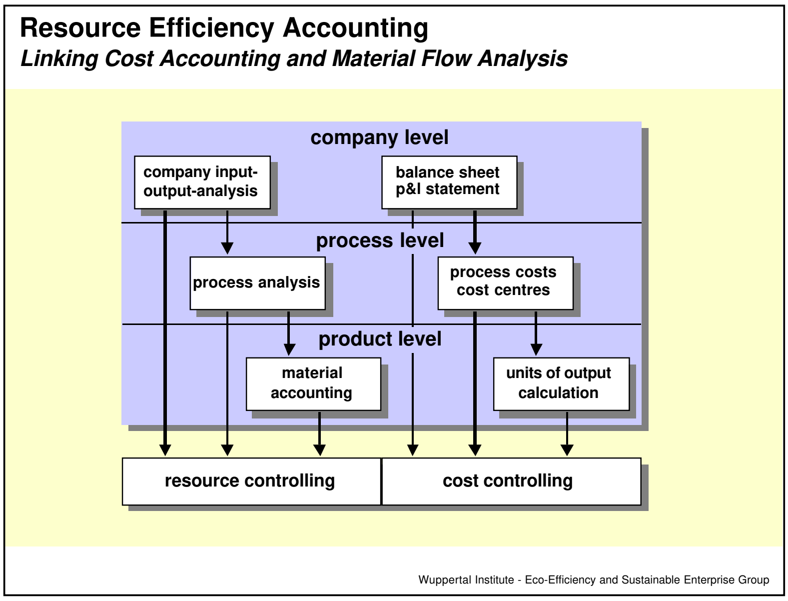

Figure 6-2: Linking conventional accounting and material flow accounting

By embracing the concept of eco-efficiency, backpack reductions can be linked to value creation and innovation. Combined cost and material flow accounting can improve business decisions in different areas, such as product and process design, purchasing, waste management, cost allocation, product pricing and capital investments. By further integrating the eco-efficiency concept into internal management, corporate reputation could be improved and stakeholder requirements more easily matched, including those of customers, retailers, employees, shareholders and investors.

The importance of the value chain, in particular downstream of production (i.e. distribution, retailer, consumer) is another key area of focus. While the possibilities to influence consumer behaviour related to shopping habits are very limited, it would be worth considering ways of reducing environmental impacts at least up to the point of sale. Co-operation along the supply chain, for example working with important retail chains on awareness raising programmes, could be one option.

Burning compressed files onto CDs partially offsets potential resource savings from downloaded music compared to the other two scenarios (see chapter 3.4). With increasing hard-disk storage capacities and portable storage devices, burning may decrease in the long term. Music delivered as streams is even less environmentally beneficial since a material intensive download is required every time the same piece of music is consumed. The MIPS analysis indicates that depending on the download time the download might have a higher material intensity than CD production.

Strategic level

… for the company: Comparing the contribution of different country units to a group-wide total environmental backpack could be one way to identify internal best-practice examples, to enhance communication between different units and to improve overall performance. The link between costs and material flows has already been highlighted. An assessment of company wide material flows will assist in value creation and innovation. As part of the company wide assessment, business related travel could be another focus area. In the physical retail scenario consumer transport emerges as third largest contributor to overall material intensity. Experience with other companies shows that business travel as well as employees commuting can be of significant relevance to a company's environmental backpack.

… for the music sector: An option that could potentially drastically reduce the floor space needed in retail outlets are technologies that could deliver CDs on request just in time (mass customisation). Song files, the booklet as well as additional information about the artist would be stored on a database with easy access for customers at the shop. If the customer intends to buy a CD, the respective files are immediately burned on a CD, a label and a booklet are printed – all in the store. This would reduce the space needed for display as well as avoiding unwanted stock and related take-back operations. Savings would not only be realised at the retailer, but also at the production site. The introduction of such a distribution system would drastically change the entire value chain. Moving to this kind of system would require cross sector cooperation between the music industry, retailers, raw material and semi-finished product suppliers etc. However, production itself is usually less efficient in distributed schemes than in large scale operations in controlled factory environments. Further research is necessary to determine whether such a system would be of overall benefit to the environment.

Increasing portability and convergence of devices (see future scenarios) may reduce the music industry's degree of influence. Producers of hardware devices that have not traditionally had close links with the music industry e.g. mobile communication devices, internet service providers and many others, will have growing influence. Cross-sector cooperation along the value chain is therefore an important issue for the business community, in particular in consumer oriented sectors, where consumer behaviour is a decisive factor. Hence product or service panels, representing the important actors such as music labels, the electronics industry, internet providers etc. as well as other relevant stakeholders, appear to be crucial in order to improve the sector's performance.

As a first step to defining a vision for its role in society, the music industry could set up a social responsibility forum representing all interests within the industry. Within the first six months, the forum should be tasked with identifying key social responsibility issues for the music industry in the digital age. Following this initial scoping, an industry-wide response to each key issue should be developed.

The following are suggested issues for discussion and action:

- **The role of music in education**

With attention focused on new technologies, there is a tendency to think that old priorities fall away. But it is often the case that technology merely reaffirms their importance. The role of music in education is one such area. Music is an important tool for individual learning and development, teaching valuable skills and building self-esteem and confidence. With social isolation as one of the potential risks of the ongoing personalisation and portability of music, participation in the creation of music could act as a powerful balancing force.

In a squeezed education curriculum, the space available for music is limited, and the cost of equipment is high. Studies in the UK indicate that good arts provision in schools is the exception rather than the rule (BBC Online). In particular, the transition from primary to secondary education sees children's exposure to music at school decline markedly (O'Neill, 2002).

More exposure to the creation of music in school could encourage children to value music and the creative talent invested in it. This could provide a solid foundation on which to build consumer understanding of copyright in the digital domain. The music industry should work closely with government to review current investment in music education to ensure that it is delivering maximum benefit in an increasingly digital environment.

- **Social inclusion**

The music industry should recognise the digital divide as a key risk issue and make a strong commitment to promoting digital inclusion as a cornerstone of social cohesion in the Information Society. The industry has a significant opportunity to promote digital inclusion in the development of inclusive service and pricing models.

The social appeal of music could be used to combat fear and irrelevance associated with technology and open up new opportunities for developing 21st century literacy. The music industry should work closely with ISPs, telecoms, governments and community-based groups to develop joint strategies.

- **The aims and value of copyright**

If copyright is not be fatally undermined in the digital age, there is a need to rebuild understanding of the aims of copyright and the value of the compromise between private reward and public good that has historically underpinned copyright. A music industry forum on social responsibility could take an active role in engaging other stakeholders including consumer and civil society groups on these issues, raising awareness of the social value of music and the longer term implications of digital piracy.

… for government: It has already been stressed that under certain conditions digital delivery of music has a lower impact on the environment than physical retail. Yet the framework conditions need to be created in such a way that allows these opportunities to be realised. Important aspects of such a framework are:

- Fast internet connections. As indicated, the speed of the internet connection is a decisive factor for electricity consumption and hence material intensity.

- Minimising non-selective downloads. A system with permanent internet connection (flat rates) and unlimited access to music files (unpaid peer-to-peer file sharing or unlimited business models) stimulates non-selective downloads in large numbers (rebound effect).

Creation of such framework conditions appears to be difficult. Promoting faster internet connections while at the same time trying to minimize the likelihood of rebound effects is a challenge.

Electricity consumption is particularly significant for overall material intensity. With an increase in broadband connections and flat rate connections, this is likely to increase even further. Apart from energy efficiency measures, renewable energy sources are a key area for improvement in this field. The EU is aiming to double the share of renewable energy to 12 per cent by 2010. A directive passed in 2001 sets an additional target to raise the share of electricity consumption from renewables to 22 per cent[64]. Though Europe's renewable energy capacities continue to grow (e.g. EU now accounts for three-quarters of global wind energy generation), initiatives and activities in the sector need to be promoted in the future. According to the European Commission, existing policies on renewables will only deliver an eight to ten per cent share of renewables.[65]

Given its strategic importance for the development of a more sustainable e-society, additional, comprehensive strategies relating to renewable energy need to be developed at the EU-level. A mix of strategies and policies to support renewable energy is essential if we are going to double the share of renewable energy. This would not only contribute to a more sustainable energy policy, but would also contribute to reaching the Kyoto targets. On a national level the "Renewable Energy Sources Act (Erneuerbare Energien Gesetz, EEG)", which came into force in April 2001 in Germany, gave an important boost to renewables at national and international levels. A central component of the act is the obligation placed on companies supplying the public grid to purchase renewable energy.[66] Similar measures should be promoted across Europe.

Whether stored on a CD or digital file, enjoying music involves various electrical and electronic devices. The EU's waste electrical and electronic equipment (WEEE) and substance restrictions (RoHS) directives passed in October 2002 encourage firms to tackle electroscrap recycling. Successful and efficient end-of-life treatment will only be achieved if companies take individual responsibility for their goods. Individual responsibility will trigger the eco-design improvements necessary to reduce the environmental effects at the source. In addition, other major barriers to improved efficiency, such as the lack of communication along the supply chain, need to be overcome. Knowledge about environmental impacts along the entire product chain is a necessary precondition for the identification of efficient improvement options.

The European Commission should review the EU Copyright Directive following its first year of implementation to assess its effectiveness at both curbing piracy and protecting public interest exceptions.

---

[64] Environmental Daily – Europé´s Environmental News Service (2002). EU set to miss renewable energy goals. Issue 1253, 9 July 2002.

[65] Environmental Daily – Europé´s Environmental News Service (2002). EU set to miss renewable energy goals. Issue 1253, 9 July 2002.

[66] Bleischwitz, R., Hennike, P. et al. (2002) Review of Eco-Efficiency Concepts in Euroe, Towards an Application of European-based Policies on Material Flow and Energy to Japanese Sustainable Develpment Policies, Wuppertal Institute for Climate, Environment and Energy, Final Report January 2002, p. 23.

At a meeting of the European Council in 2003, EU heads of state agreed to push for tighter rules against piracy, and a group of MEPs is pushing for a declaration on piracy and counterfeiting. Alongside immediate responses, governments need to build greater public awareness of the economic and social value of Europe's creative industries as part of a longer term response to digital piracy.

References

Austrian Government (1995): *National Environmental Action Plan*. Vienna.

Barthel, Claus, Lechtenböhmer, Stefan & Thomas, Stefan. (2001). *GHG Emission Trends of the internet in Germany*. In Langrock, Thomas, Ott, Hermann E. & Takeuchi, Tsuneo. (2001) *International Climate Policy & the IT-Sector* (55-70). Wuppertal, Wuppertal Spezial 19, Wuppertal Institute.

BBC Online, UK Music Sales Keep Rising, 17th May 2002 [Online] Available: http://news.bbc.co.uk/hi/english/entertainment/music/newsid_1994000/1994538.stm

Biddle et al, (2002) The Darknet and the Future of Content Distribution, Microsoft

Booz Allen Hamilton (2002) International e-Economy Benchmarking:The World's Most Effective Policies for the e-Economy

Ciancutti & Steding (2000) Built on Trust: Gaining competitive advantage in any organisation, Contemporary Book, Chicago, Illinois

Cole, A., "Play it again, man", Modern Maturity, July-August, 42(4), 10-12

Coyle, Diane (2001) Paradoxes of Prosperity, Capstone, London

Croner, Chris & Byson, Simon. (2002). *Music for Hire: Will subscription boost online sales*? Broadband Media.

Cyber Atlas. (2002). *Music Fans Rip More, Spend More*. [Online]. Available: http://cyberatlas.internet.com/big_picture/applications/print/0,,1301_1025351,00.html [2002, May 9]

DeNora, T. (2000) Music in Everyday Life, Cambridge University Press, Cambridge

Department for Education and Skills (2001) Cybrarian Scoping Study, London

Department for transport, local government and the regions (DTLR) (2002). *The Impact of Information and Communications Technologies on Travel and Freight Distribution Patterns: Review and Assessment of Literature*. Final Report by Hop Associates in association with Transport Research Group at the University of Southampton.

Eco-Cycle Commission (1997): *Hallbrat Sa Klart – en Kretsloppsstrategi*. Kretsloppsdelegationens Rapport 1997/13. Stockholm.

Florida, Richard & Gates, Gary (2001) Technology and Tolerance: The importance of diversity to high-technology growth, Brookings, Washington

German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (1998): *Sustainable Development in Germany – Draft Programme for Priority Areas in Environmental Policy*. Bonn, Germany.

Graziano, M., (2001), The music downloading deluge, Pew Internet and American Life Project

Infratest Burke. (2000). internet-*Nutzung nach Dauer in Prozent der internet-Nutzer 2000 in Deutschland* [Length of internet usage in Germany 2000]. Quoted in: Bundesministerium für Wirtschaft und Technologie [German Federal Ministry of Economics and Technology]. (2001). *Monitoring Informationswirtschaft* [Monitoring Information Economics] – study by Infratest Burke GmbH & Co. and the Institute for Information Economics. Berlin: BMWi.

INSEAD. (2001). *Music on the internet: Transformation of the Industry by Sony, Amazon.com, MP3.com and Napster*. INSEAD, Fontainebleau, France.

Kao, John (1996) Jamming: The art and discipline of business creativity, Harper Collins, London

Krachtwerktuigen Bedrijfsadvisours B.V. (1998). *Roundabout: Closure of the compact disc circle. Reduction of the environmental burden within the compact disc chain*. Final report (short version), 27 October 1998.

Krachtwerktuigen Consultancy. (1997). *Roundabout: Closure of the compact disc circle. Reduction of the environmental burden within the compact disc chain*. Interim report, 18 December 1997.

MediaGruppe. (2000). *Ein Drittel der internet-Nutzer suft täglich* [One third of the internet users surfs on a daily basis]. MediaGruppe and Tomorrow Magazin.

MediaGruppe Digital. (2001). *@factsmonthly – Januar 2001*. Unterföhringen, Germany: MediaGruppe Digital.

Ministry of Housing, Spatial Planning and the Environment (1996): *Dutch bill extending the Environmental Management Act to provide for environmental reporting* (Engl. translation), The Hague 1996

Nielsen NetRatings. (2001). *Average minutes per visitor to top internet sites in November 2001*. In: Croner & Byson. (2002). *Music for Hire: Will subscription boost online sales*? Broadband Media.

North, A.C., Hargreaves, D.J. and O'Neill, S.A., (2000), "The importance of music to adolescents", British Journal of Educational Psychology, 70, 255-272

O'Neil, O (2002) A question of trust, Cambridge University Press

Optical Storage Technology Association (OSTA). (2002). *CD-R and CD-RW Questions and Answers Manufacturing Process*. [Online]. Available: http://www.osta.org/technology/cdqa6.htm [2002, May 15].

Orwat, Carsten. (2002). *Innovationsbedingungen des E-Commerce – der elektronische Handel mit digitalen Gütern* [Conditions for Innovations in the area of E-Commerce]. Büro für Technikfolge-Abschätzungen beim Deutschen Bundestag, Hintergrundpapier Nr. 8.

Perri 6 (1997) Escaping poverty: from safety nets to networks of opportunity, Demos, London

Reich, Robert (2001) The Future of Success, Vintage, London

Rifkin, Jeremy (2000) The Age of Access, Penguin, London

Rose, John, Recorded Music Industry: Strong Fundamentals, Strong Future, JP Morgan Music Conference, 25th September 2002

Schmidt-Bleek, F. (2000), *"Factor 10 Manifesto"*, Factor 10 Institute, La Rabassière, F-83660 Carnoules, France, January 2000.

Schmidt-Bleek F. (1994), *"How much environment needs the human?" MIPS - the indicator for ecological societies (Wieviel Umwelt braucht der Mensch? "MIPS - Das Mass für ökologisches Wirtschaften")* Boston/Basel/Berlin: Birkhäuser Verlag.

Schmidt-Bleek, Friedrich, Bringezu, Stefan, Hinterberger, Friedrich, Liedtke, Christa, Spangenberg, Joachim, Stiller, Hartmut & Welfens, Maria Jolanta. (1998). *MAIA – Einführung in die Material-Intensitäts-Analyse nach dem MIPS-Konzept* [MAIA – Introduction into the material intensity analysis based on the MIPS concept]. Berlin, Basel, Boston: Birkhäuser.

Schmidt-Bleek, F. (1993). *MIPS- Revisited*. Fresenius Environmental Bulletin, 2, 407-412.

Shearman (2000) Local Connections: Making the net work for people and communities, Communities Online

Shirky, Clay (2002) Weblogs and the mass amateurisation of publishing [Online]. Available: http://shirky.com/writings/weblogs_publishing.html

Sinnreich, Aram & Mulligan, Mark (2001) European Digital Music Sales, Jupiter Media Matrix

Stephens, T., Braithwaite, R.L. & Taylor, S.E. (1998). Model for using hip-hop music for small group HIV/AIDS prevention counselling with African American adolescents and young adults, Patient Education and Counselling, 35(2), 127-137 [Online] Available: http://www.powerofmusic.org

The Children's Partnership (2002) Online Content for Low-Income and Undeserved Americans, Washington

The Factor Ten Club. 1997: *The Carnoules Declaration- Statement to Government and Business Leaders*; Wuppertal Institute for Climate, Environment and Energy; Wuppertal, Germany.

Türk, Volker. (2001). *Assessing the Resource Intensity of the internet Infrastructure: Data Analysis for a Material-Flow Oriented Approach and First Results on Electricity Consumption*. M. Sc. thesis at the Lund University, Sweden. [Online]. Available at: http://www.iiiee.lu.se/information/library/publications/2002/volker.html.

Weizsäcker, E., Lovins A. B., Hunter Lovins, L. (1997): *Factor Four Doubling Wealth - Halving Resource Use*, London: Earthscan Publications Ltd.

Wellman et al (2002) Is there a Place in Cyberspace: The uses and users or public internet terminals Online available at – http://www.chass.utoronto.ca/-wellman/publications/index.html

Whatis?com. (2001). *CD-R.* [Online]. Available: http://searchStorage.techtarget.com/sDefinition/0,,sid5_gci508073,00.html [2002, July 15].

EMI specific information

EMI, 04 December 2002. Notes from a meeting with representatives from EMI and Digital Europe.

EMI, 23 July 2002. Email from Kate Dunning to Michael Kuhndt.

EMI, 17 May 2002. Email from Senta Schiffeleers to Michael Kuhndt.

EMI, 13 April 2002. Email from Kate Dunning to Michael Kuhndt.

EMI, 02 April 2002. Email from Jeanine van der Sterren to Volker Türk.

EMI, 22 March 2002. Visit of WI staff at EMI headquarter in London, including a meeting with representatives from OD2.

EMI, 05 March 2002. Site visit of WI staff at EMI's production site in Uden, the Netherlands, including a meeting with key EMI staff (Kate Dunning, Jeanine van der Sterren, Senta Schiffeleers)

EMI, 09 Januar 2002. Email from Jeanine van der Sterren to Justus von Geibler.

EMI Group. (2002): *Environment & Community Summary Report 2002*.

EMI Compact Disc (Holland). (2001). *Environmental Statement of EMI Compact Disc (Holland) bv*.

Glossary

CD-R	Compact disc – recordable; blank CD
CD-ROM	see CD-R
GB	Gigabyte
LCA	Life-Cycle Analysis
MIPS	Material Input Per unit Service
NDC	National Distribution Centre
OD2	a UK-based music subscription platform provider
OECD	Organisation for Economic Cooperation and Development
PC	Polycarbonate
PE	Polyethylene
PS	Polystyrene
USB	Universal Serial Bus