

The Environmental Impact of Getting the News

A Comparison of On-Line, Television, and Newspaper Information Delivery

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Keywords

electricity mix
information and communications
technology (ICT)
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Summary

The environmental impact associated with reading an on-line and a printed newspaper is analyzed and compared with respective parts of a television (TV) broadcast. Two reference units were chosen for comparison to account for differences between media in presentation and consumption (reading or watching a news item) and consumption of the daily news as a whole. The environmental impact is assessed using life-cycle assessment (LCA).

Key drivers of the environmental impact for both electronic delivery systems are energy consumption and power generation. Not only do the manufacturing of the products and their use have an environmental impact, but so does the use of the necessary infrastructure, that is, energy consumption of the telephone network or data transfer via Internet. Printing of on-line information also turned out to be important.

In the case of the printed newspapers, energy consumption is again important, here for the manufacturing of pulp and paper. Complete printed newspapers (the form in which they are typically purchased) have a very high environmental burden relative to watching the TV news or reading on-line news, even if the propensity to extend TV viewing is taken into consideration.

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Introduction

Electronic media are frequently seen as providers of “dematerialized” services, particularly in comparison to print media. It is often thought that a letter sent by e-mail has less environmental impact than a letter sent by surface mail, and a similar view is taken of the use of an on-line directory relative to a print directory. Zurkirch and Reichart (2001) have already shown that in such cases, in-depth analyses do not necessarily provide the expected clear-cut answers. Instead, some consumer-related parameters determine the environmental impact. These are the size of the data packet sent and the distance to its final destination, in the case of sending a letter, and frequency of use, in the case of the telephone directory (Zurkirch and Reichart 2001). In addition, peripheral actions such as the length of time for writing a letter on a computer and whether anything is printed on a private printer are decisive.

In this case study, another application of the Internet was investigated: **Reading an on-line newspaper was compared with reading a printed newspaper, and both were compared with watching the news on television (TV).** According to user surveys, being informed about the daily news is one of the most important reasons for accessing the Internet (WEMF 2002), reading printed newspapers, and watching TV (Ringier 2001).

Scoping

Goal

The study described here aims to quantify the environmental impact of reading the daily news in printed and on-line newspapers and watching it on TV, and it includes an identification of the key drivers for the impact. This is achieved by applying the method of life-cycle assessment (LCA) whereby the environmental impact of the products concerned is investigated throughout the product life cycle, that is, from “cradle to grave.”

Functions of the Media Investigated

Before detailing the comparison of the daily news in printed and on-line newspapers and on TV, it is necessary to examine the similarities and

differences between media. Obviously the amount of news consumed, and the media chosen, vary from person to person and from day to day. In order to keep this study manageable and still gain an initial insight into the environmental impact, average user behavior was assumed, as in most LCA studies (Udo de Haes 1997). Here, average user behavior refers to each of the three universes of Internet users, TV viewers, and newspaper readers, as characterized by typical Swiss-German users.

Furthermore, **important differences and similarities exist** in the way daily news is presented in each of the media. Printed newspapers are typically structured in news sections by subject area. Each section consists of a series of articles, which again are composed of printed text and photographs. The number of articles, number of words per article, ratio of picture to text, and text formats vary between newspapers. On-line editions of the same newspaper are structured similarly, but the number of articles, as well as their size, is typically reduced. The main difference between the on-line and the printed newspaper is the option of access to other sources of information on the Web. TV news again is structured differently relative to a newspaper. The sequence and selection of news items depend on the importance of news events. News items consist of spoken text, still pictures, and film sequences.

The media also vary with respect to the sensationalism (or emotionality) conveyed. On the one hand, the tabloid (boulevard) newspapers contain many pictures and short articles written in a style that evokes the emotional involvement of readers. On the other end of the spectrum are sophisticated newspapers, containing articles about politics, business, and so on, with pro and con arguments frequently leaving opinion making to the reader. TV newscasts also convey emotions. Film sequences are an important aspect in evoking the emotional involvement of TV viewers through direct presentation of an event. The selected film clips and the emotions conveyed depend to a great degree on the specific TV channel and the journalistic and programming strategies it has chosen. These differences most likely affect the way end users interact with the medium, but a complete exploration of the ramifications is beyond the scope of this study.

Accounting for all of these differences between media would necessitate comparing fictive “average” media. Instead, existing and widely used Swiss-German media were chosen for investigation:

- **Print edition of *Neue Zürcher Zeitung* (NZZ).** NZZ is a daily newspaper with the fifth highest circulation in Switzerland (NZZ 2002). It is a newspaper written in a sophisticated style, with comparatively few photographs (and only in black and white) and emphasizing well-balanced information.
- **Print edition of *Blick*.** *Blick* has the highest circulation of a daily newspaper in Switzerland (NZZ 2002). It is a tabloid newspaper with a large number of color photographs, fewer and shorter articles than NZZ, and bigger type size.
- **On-line edition of NZZ** (www.nzz.ch). NZZ On-line is more or less a copy of the print version, only slightly cut down.
- **On-line edition of *Blick*** (www.blick.ch). *Blick* On-line is again more or less a copy of the print version, only slightly cut down.
- **The main news and weather forecast starting at 7:30 p.m. on the Swiss-German TV channel SF 1.** This is the TV channel, and in particular the newscast, most viewed by Swiss Germans (Publisuisse 2002a, 2002b). Factual and background information is given, and the level of emotions conveyed is somewhere between *Blick* and NZZ.

NZZ as a sophisticated newspaper and *Blick* as a tabloid newspaper can be considered opposing end points of the spectrum of intellectual demand on the reader. The TV newscast ranges somewhere in between. Obviously there are large differences between these newspapers and the TV newscast, and care must be taken in choosing the basis of comparison and interpretation of results. To control for some of the differences, two functional units (in the terminology of LCA) were chosen for comparison.

Functional Units

A News Item

The first functional unit is reading or watching a single news item. All five media were com-

pared by choosing a news event published or broadcast on the same day in all five media. Thus, similar information content was compared. News items that occur in all five media are typically restricted to national or international news of high importance, with an emotional edge, and the weather forecast. To account for variability in length of broadcast time or size of news items, four particular news items were chosen. These were the weather forecasts on two days, the resignation of a Swiss politician, and the trial of the Swiss leader of a sect.

As a next step, the functional unit is being quantified for each of the media, defining its reference flow. The time duration was measured for the particular parts of the TV newscasts pertaining to these news items. The time for three employees at the Swiss Federal Laboratories for Materials Testing and Research to read the on-line news item was also measured. The opening of the page was included, starting from the home page of the on-line newspaper. The printed news item was looked at only as a cutting. To calculate the average material input required for the paper version of the articles, their size was determined for both text and picture(s), and a proportional share of the margin of the newspaper was added. As newspapers are printed on both sides, only half of the size was included. Advertisements were not included for any of the media, not even proportionally, nor was waiting time for a particular TV news item.¹ Of course, a drawback of this comparison is the fact that newspapers can only be bought as a whole and TV newscasts are viewed not only for a news item; these aspects are addressed in the second functional unit. This reference unit was chosen to approximate functional equivalence as closely as possible. Plätzer (1998) chose a very similar functional unit for his comparison of on-line and printed newspapers.

The resulting reference flows for the first functional unit, a single news item, are shown in table 1. The range as well as median values are given in aggregate for TV broadcast and on-line and printed newspaper. Values for both on-line and print newspaper were aggregated. To facilitate the graphical representation of results, the following were chosen as a basis of comparison: 180 sec watching TV, 90 sec of opening and reading an on-line newspaper, and 250 cm² of printed

newspaper. Reference flows for the entire range of values are shown in table 1.

Daily News

The second functional unit is reading or watching the daily news entirely, including advertisements in newspapers, banners in on-line newspapers, and advertisements in between the TV newscast and weather forecast.

Reference flows were determined by measuring the typical length of time for the evening news on TV including the weather forecast. The average reading time for on-line newspapers was based on estimates for the duration of sessions at on-line newspapers and magazines. A distinction between *Blick* and *NZZ* on-line was not possible because of a lack of data. The reference unit of the printed newspaper is the average of print editions of *Blick* and *NZZ* without advertising supplements.² The average number of 2.3 readers (WEMF 2000) was taken into account. Reference flows are summarized in table 2. As most of the reference flows depend on estimates, sensitivity analyses were conducted to test for a change of results and to account for the option of on-line access to other sources of information as well as for the possibility of shared TV watching.

Product System

The user is assumed to be an adult consumer in Switzerland who owns and uses a computer, TV, and newspaper in an average way. Therefore, the TV set and computer product systems were specified as modern, middle-class products, typical of Swiss households (table 3). The product system for the printed newspapers are *Blick* and *NZZ* without the advertisement supplement or, in the case of the first functional unit, the average newspaper.

System Boundary and Allocation Methods

The system boundary was drawn around the entire life cycle of the TV set, the computer, and newspapers, including transportation and distribution processes. Specifically, the processes described below were included.

Newsprint paper for *Blick* and *NZZ* is bought from several manufacturers. Paper with a high share of virgin fibers is typically imported from Scandinavian countries, whereas paper with a high percentage of recycled fiber is produced in Germany or Switzerland. Printing of newspapers (offset, principally rotary, printing) takes place

Table 1 Reference flows for a single news item

	TV broadcast (sec)	NZZ on-line newspaper (sec)	Blick on-line newspaper (sec)	NZZ printed newspaper (cm ²)	Blick printed newspaper (cm ²)
Weather 1	238	76, 37, 165*	64, 61, 124*	478	173
Weather 2	217	56, 35, 34*	79, 33, 49*	529	185
Resignation	150	273, 218, 237*	97, 69, 95*	175	332
Trial	142	167, 107, 120*	113, 58, 79*	135	181
Range	142–238	33–273		133–520	
Value used in study (median value)	180 (184)	90 (79)		250 (183)	

* The three figures indicate actual values.

Table 2 Reference flows of daily news

	TV broadcast	On-line newspaper	Thin tabloid newspaper	Voluminous sophisticated newspaper
Length of time or size	25 min	10 min	43%* of <i>Blick</i>	43%* of <i>NZZ</i>

*2.3 readers on average are assumed to read each copy of the newspaper, and thus the mass of the functional unit of the newspaper is adjusted accordingly.

Table 3 Product systems

	TV set	Computer	Printed newspaper
Product	Cathode-ray tube TV ¹ Color TV 72 cm diagonal 4:3 format 50 Hz	Multi-media desktop PC ⁶	Functional unit, "news item": cutting of an average newspaper ¹¹ Functional unit, "daily news": two distinct newspapers per 2.3 readers each. ¹² • 43% of <i>Blick</i> (32 pages $\cong 100\text{g}^{13}$, on average 73% recycled paper mass) • 43% of <i>NZZ</i> (82 pages $\cong 280\text{g}^{13}$, on 13% recycled paper mass)
Power consumption	Unplugged: 0 W Standby: ² 5 W On: ² 94 W 90% of time in standby ³	Unplugged: 0 W Standby: ⁷ none Active mode: ⁸ 145 W	
Lifetime	8 yr ⁴	4 yr ⁹	1 day
Hours of operation in active mode (computer) or on (TV)	253 min/day ⁵	120 min/day ¹⁰	

¹ TV sets with this specification had the highest market share in Switzerland in 1999. TV sets with modern features such as 100 Hz or flat screens were purchased in much smaller numbers (Langlotz 1999; Loosli 1999; Walter 1999).

² Average power consumption of TV sets described above produced in 1998–1999 (Meyer and Schaltegger 1999; Schaltegger, 2000).

³ Assuming that TV sets are being unplugged only during longer absences, such as holidays (10% of time).

⁴ The average lifetime of TV sets handed over for disposal is 8 to 10 years in Switzerland (Thanner 1999). Considering that 100 Hz, wide-format, and flat-screen TV sets have gained market share, common "old-fashioned" TV sets are likely to have a shorter life expectancy than 10 years; therefore, an 8 year span is used in this study.

⁵ The average turn-on time of TV sets in Swiss households in 1998 (Jedele 1999).

⁶ The majority of computers bought and in use are still desktop models, rather than laptops, in 2002 in Switzerland (Weiss 2002a, 2002b).

⁷ Assuming that privately used computers are either actively used or disconnected (no standby mode was modeled because of the lack of consensus in the research literature on estimates of length of "time on" and length of time in standby mode).

⁸ Average power consumption (in active mode) of computers bought in 1998–1999 in Switzerland (Pentium/Pentium II/MMX) and 17 inch monitors based on C't, a German-language computer magazine, and manufacturer's information (Meyer and Schaltegger 1999, 2000; Kawamoto et al. 2001).

⁹ Private desktop computers including displays are assumed to be replaced, on average, just before every other launch of a new Windows software package. The lifetime of residential desktops and displays in the United States is estimated to be 4 years (Kawamoto et al. 2001).

¹⁰ Estimate based on the fact that average Internet use at home is already 74 min per day per adult in the Swiss-German part of the country (NZZ 2000). U.S. residential usage of desktop computers is estimated to be 10 hr/wk (or about 86 min/day) in active mode (Kawamoto et al. 2001).

¹¹ Here, the average newspaper is defined as the environmental impact per average paper mass for *Blick* plus the environmental impact per average paper mass for *NZZ*, all divided by 2.

¹² The average number of 2.3 readers per newspaper (WEMF 2000) is taken, which in turn leads to 43% of the environmental impact of each paper allocated to each reader.

¹³ The average of all annual editions, no advertising supplements included. Unsold copies not included. (As with the discussion of whether to include advertising supplements in the system boundaries, others might argue that unsold copies are central to the business model of the newspaper and thus should be included.)

near Lucerne and near Zurich. Manufacturing processes were modeled according to process data obtained from the paper manufacturers and printing plants. Upstream processes such as heat generation from fossil fuel or biomass were modeled according to information from paper manufacturers complemented with standard LCA inventory data (described in table 4). The power supply is modeled on the national level, depending on the location of power consumption, that is, the German, Swiss, and various Scandinavian

electricity mixes. Transportation processes as well as distribution to customers are included within the system boundary. Distribution is modeled according to the occurring modal split: transport to central locations via van and from there to points of sale and households via van, car, moped, and foot.

Paper recycling was accounted for by applying the allocation method based on the number of subsequent uses, in accordance with ISO 14049³ (ISO 2000). The average number of cycles of

Table 4 Important data sources for the inventory

	Source
Manufacturing of TV	Gensch and Quack (2000) based on Strubel and colleagues (1999)
Manufacturing of computer: manufacturing of monitor, PWB (printed wiring board) including components and cabinet	Transfer of data from Gensch and Quack (2000) based on Strubel and colleagues (1999); ¹ different weights of components were accounted for proportionally.
Manufacturing of computer: remaining parts	Various data from APME (1993–2000) and Frischknecht and colleagues (1996)
Manufacturing of newsprint paper	Process data from paper manufacturers in Scandinavia, Germany, and Switzerland of the years 1998–2000; ²
Energy consumption of the TV and computer	Meyer and Schaltegger (1999)
Energy consumption of the telephone network	Proprietary data from a company running the telephone network
Energy consumption of the Internet	Estimates based on energy consumption of two (intensively and intermittently used) routers (plus modems and cooling) divided by average size of data packets sent ³
Electricity mix for Norway, Sweden, Germany, Switzerland, and the Union for the Coordination of Transmission of Electricity	Habersatter and colleagues (1998) and accounting for power imports in Switzerland according to model M2 of Ménard and colleagues (1998)
Disposal of part of the newspaper: waste incineration	Data bank of Ifu and Ifeu (2000)
Disposal of electronic waste: shredding	Average power consumption Behrendt and colleagues (1998)
Waste incineration for plastic fraction of shredding	Data bank of Ifu and Ifeu (2000)

¹ The data source quoted in this study includes primary as well as secondary aluminum and copper and primary steel. Under these circumstances, it seemed impossible to give a credit for metal recovery, because the exact amounts of primary or secondary material in Gensch's work (2000) are not known. Therefore, a cutoff seemed the best solution.

² The specific paper supply of both of the newspapers is covered entirely. Upstream processes for fossil fuels rely on various sources. Further information is available from the author upon request.

³ Estimates of energy consumption per size of data package were sought, but studies such as that by Roth and colleagues (2002) do not offer that sort of information, only energy consumption of the entire router, switches, and so on. We addressed this choosing a CISCO router (500 W) with a high amount of data throughput (for further information about the size of data packages per time, see (www.switch.ch)) and a local router (160 W) at our institution with comparatively little data throughput. For a rough estimate, we calculated average energy consumption per data package.

wood fiber in Swiss newspapers and magazines is 2.3 (our calculation). This compares well to 2.32 cycles in Germany, with its similar recycling situation (Plätzer 1998). A credit was given for re-captured heat and power through waste incineration of the remaining 35% of the newspaper. This percentage of newspaper is not collected, but assumed to be disposed of with household waste.

Manufacture of the TV set was modeled by taking inventory data from the work of Gensch and Quack (2000). The power supply was modeled as the German or European electricity mix. As a result of the lack of other adequate data sources, manufacturing of the computer was modeled using inventory data of the TV's printed circuit board assembly, its cabinet, and its cathode-ray tube (table 4).

For the use phase of the TV set and computer, the Swiss electricity mix was assumed, because the use of media was assumed to take place in Switzerland. A sensitivity analysis was conducted for the use phase, replacing the Swiss electricity mix with the average of the European electricity mix as determined by the Union for the Coordination of Transmission of Electricity, the organization responsible for the interconnected electricity network in central Europe.

Operation of infrastructure was also taken into account, that is, power consumption for data transfer via the Internet, operation of the telephone network, production of TV shows, and operation of a satellite receiver (Meyer and Schaltegger 1999, 2000). The manufacture and disposal of that infrastructure were not included in the system boundary.

The disposal of electronic goods was modeled according to the Schweizerischer Wirtschaftsverband der Informations-, Kommunikations- und Organisationstechnik (Swiss Trade Association of Information, Communications and Organizational Engineering) (SWICO) take-back concept for TV sets in Switzerland, but in a simplified way. The SWICO take-back system is a free-of-charge take-back system in Switzerland for TV sets that has been adopted as the preferred way of disposal by many businesses and consumers. For this study, a combination of manual disassembly and semiautomatic shredding was assumed.

The plastic fraction is typically incinerated, glass is mostly cycled down or landfilled, and iron, copper, and aluminum are recovered by smelting.

Burning of the plastic fraction was modeled, whereas glass and metal recycling was not, because of the large loss of value in the cycling down of glass as well as the need for simplification of the analysis.

In the case of the TV set and the computer, only a very small fraction of the use phase was relevant; therefore, only a small proportion of the environmental impact of manufacturing and disposal was accounted for. This proportion was determined as the duration of the investigated use phase as a fraction of the total time the product is in active mode.

Journalism and transportation processes associated with it were left out of the system boundary for reasons of simplification. A generalized system boundary is shown in figure 1.

Data Sources

The main data sources for the inventory are summarized in table 4.

Assessment

Two internationally recognized assessment methods were applied: the method of "environmental scarcity" (Brand 1998) applicable to Switzerland for the year 1997 and the Eco-Indicator 99 method (PRé 2000) applicable to Europe for the year 1999. The first method emphasizes energy consumption and its related air emissions, although some emissions to water and land are also evaluated. The second method includes many environmental problems (e.g., ecotoxicity, human toxicity, land use, etc.), but energy consumption still scores rather high. This derives in part from the current level of knowledge in this area: Greenhouse effects are relatively certain (which gases contribute, even their relative contribution in strength), but knowledge of ecotoxicity is still rather limited. A comparison of impact assessment methods is provided by Stahel and colleagues (1998), and general discussions about valuation in LCA are given by Finnveden (1997) and Hofstetter (2002).

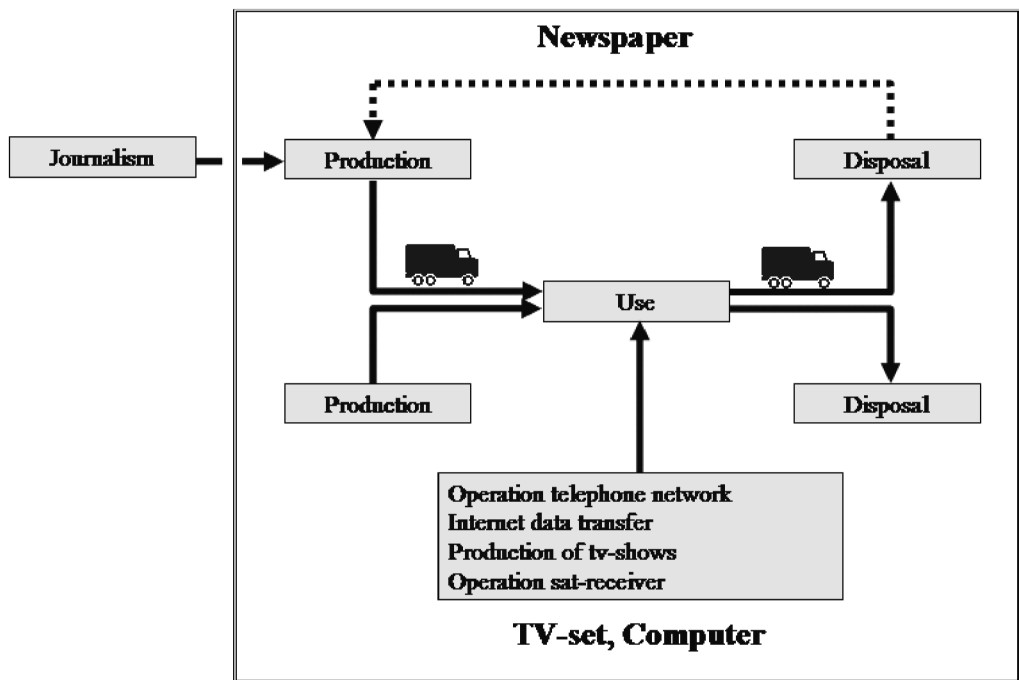


Figure 1 System boundary for environmental analysis of news delivery.

Results and Discussion

Results for a News Item

The environmental impact of watching or reading a news item is summarized in figures 2 and 3. The first of the two figures gives the result after assessment with the environmental scarcity method, the second after assessment with Eco-Indicator 99. Figure 2 shows the contribution of life-cycle stages for each of the media. The total environmental impact from the range of reference flows (table 1) is indicated by the thin bars. The results of the assessment for life-cycle stages with Eco-Indicator 99 are not shown separately because the results are very similar to figure 2. Instead, contributions of impact categories to the fully aggregated Eco-Indicator 99 result are depicted in figure 3.

The newspaper cutting causes the least environmental impact, even considering that its environmental impact varies with the size of the article (note the range indicated by the thin bar in figure 2). Reading a news item in the on-line newspaper and watching a news item on TV are associated with more environmental impact. The

total environmental impact of reading an on-line news item varies substantially with the time needed to open the Web page and the speed of reading. As TV news items are much more restricted in length of time, the total environmental impact varies less accordingly. Even though the range of the environmental impact of watching a TV news item and reading an on-line news item overlap, chances are high that the environmental impact of the second will still be higher because its range extends to 8 eco-points (figure 2). The high environmental impact of the on-line news item is caused by the production phase of the computer and the use phase for the Internet. The high impact of manufacturing the computer relative to the TV can be explained in part by the larger proportion of the manufacturing impact allocated. That larger proportion is attained by dividing the 90 sec of reading time for the Internet news by the comparatively short length of time the computer is actively used overall. Figure 4 gives more detail about the other important life-cycle stage: the use phase of reading an on-line newspaper. Figure 4 shows the environmental impact or proportional power con-

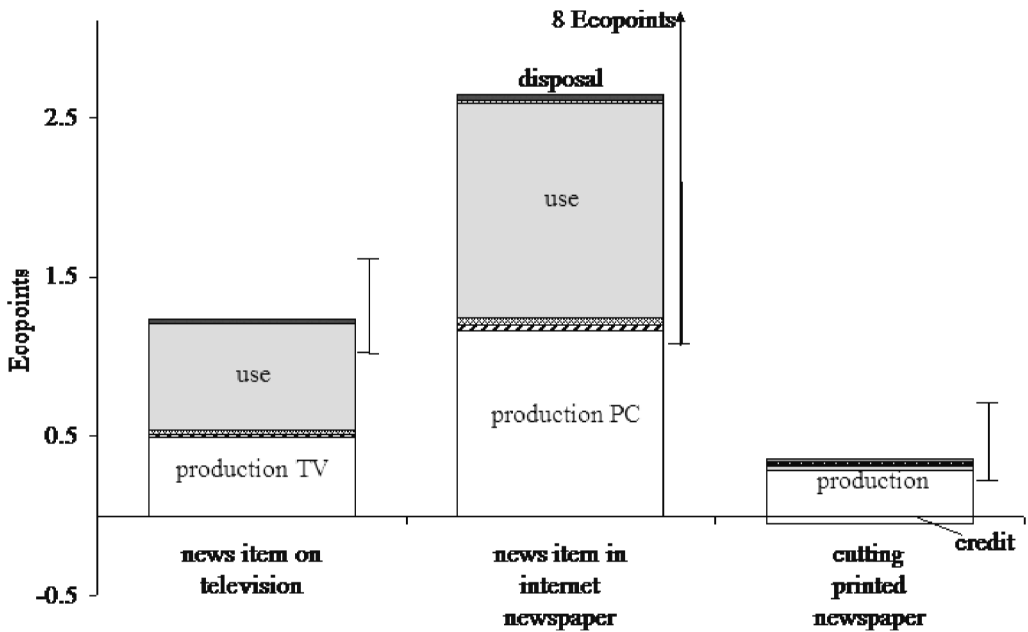


Figure 2 Environmental impact of reading or listening to a news item, disaggregated into life-cycle stages. The environmental impact is expressed in the eco-points of the environmental scarcity method. Thin bars to the right of each bar indicate the total potential environmental impact when taking the range of reference flows into account.

sumption of the use phase of the computer and necessary infrastructure. Interestingly, the computer only uses one-fifth of the overall electricity consumption, and operation of the telephone network is the dominant consumer in this instance.

Daily News

The environmental impact of watching or reading the daily news as a whole (the second functional unit) is shown in figure 5. Results are only shown for the environmental scarcity method, because Eco-Indicator 99 led to similar results. In contrast to the previous approach, more environmental impact is attributable to both of the newspapers than to reading an on-line paper or watching the TV broadcast, even though only 43% of either newspaper was allocated to a reader. Most of the newspapers' environmental impact originates from the production phase. Figure 6 shows that particular life-cycle stage in closer detail. About three-quarters of the impact is caused by the production of the news-

print paper, and there again the main drivers are power and heat consumption.

Because the length of time for consuming the daily news on TV and on the Internet was estimated, a sensitivity analysis was conducted. Thus, the options of watching documentaries as further sources of information on TV, shared TV viewing, and using links to other sources of information on the Internet are also included in the comparison. Figure 7 shows the environmental impact expressed in eco-points as a function of length of time for news consumption. The environmental impact of either newspaper is invariant with respect to time because only its physical existence matters; that is, its use-phase impact is zero. The horizontal bar indicates the range of the environmental impact attributable to newspapers, still under the assumption that there are 2.3 readers per newspaper. If only a single reader per newspaper were assumed, the impact would rise 2.3-fold. As long as watching TV does not take more than 80 min, its environmental burden is smaller than reading a thin (32 pages) newspaper. In contrast, only 20 min of

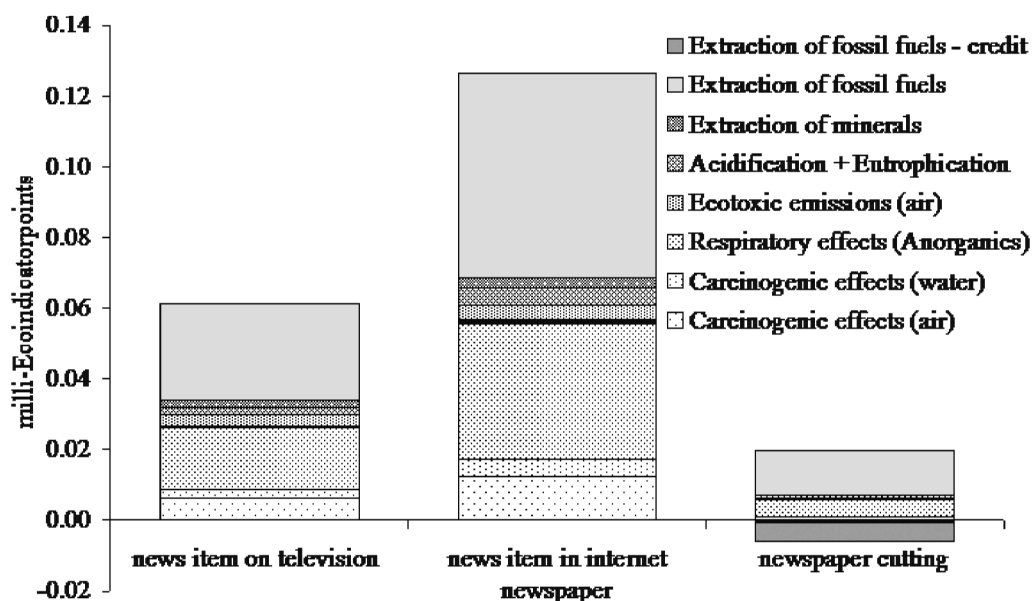


Figure 3 Environmental impact of reading or listening to a news item disaggregated by impact categories. Main contributors to the result are “extraction of fossil fuels” and “respiratory effects through inorganic substances” (including particulates). The most important process contributing to both impact categories is power generation. The environmental impact is expressed in milli-eco-indicator points as calculated according to the Eco-Indicator 99 method. Only impact categories large enough to identify in the figure are indicated in the legend.

Internet surfing are enough to generate an environmental impact equivalent to a thin newspaper. If in addition three pages of on-line news are printed, less than 10 min of Internet surfing are necessary to match the environmental impact of a thin newspaper. The increased impact from printing on-line information is primarily driven by the production of pulp and paper and not the printing process itself.

A further sensitivity analysis was carried out for location of media use. The Swiss electricity mix, which was assumed for the use phase, was replaced by the average European electricity mix. This replacement represents the use of media in Europe as an average. The exchange of the electricity mix results in a tripling of the environmental burden of electronic media in relation to the reference setting (figure 8). Even watching TV causes nearly the same environmental impact as reading a thin newspaper. The reason for this increased environmental impact is the higher percentage of fossil fuels in the European electricity mix relative to the Swiss electricity mix. The Swiss mix is not based on fossil fuels,

but on a large share of hydropower. Fossil fuels are included as a small part of the Swiss electricity mix to account for imported power.

Conclusion

The motivation for the first approach, using a news item as a functional unit, was to compare media on the basis of similar information content. This was achieved by focusing only on a small aspect of the active use of media while leaving out activities such as switching channels on TV, surfing Web sites, or flipping through most of the sections of a newspaper. The comparatively small environmental impact of the printed newspaper seen in this approach only translates into reality if there is the opportunity to buy parts of a newspaper. Printing on demand may offer such possibilities in the future if public machines offering that service are widely utilized and newsprint paper is used for such printing.

The comparatively high environmental impact for Internet use seen in the first approach gave interesting insight, as about half of the im-

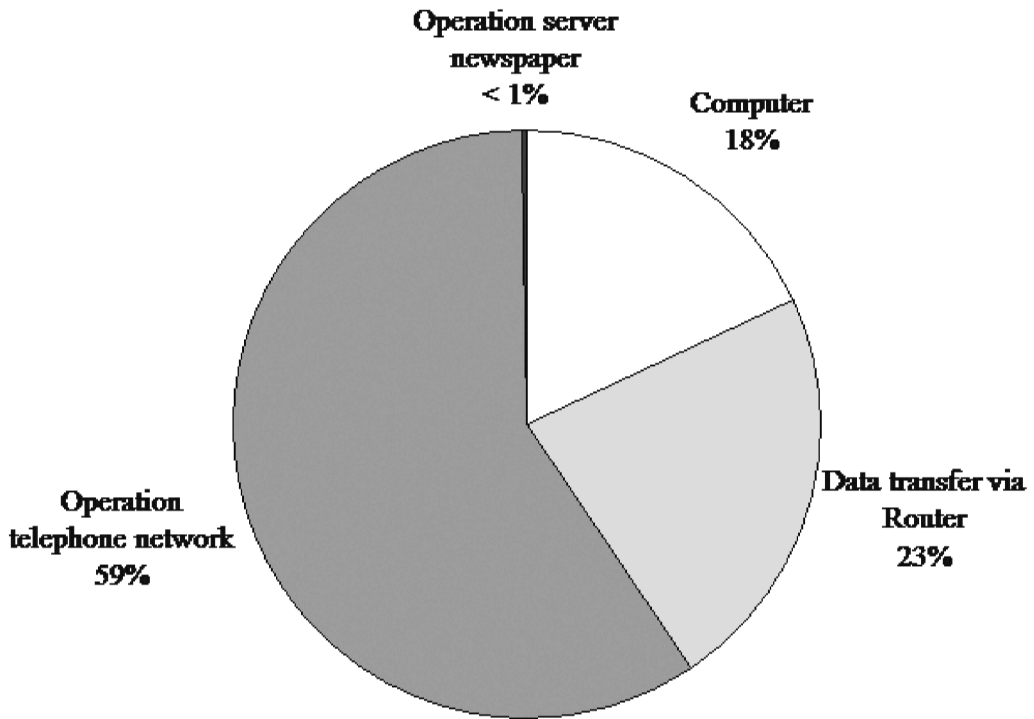


Figure 4 Relative power consumption and environmental impact of use phase only for reading an on-line newspaper: Operation of the telephone network consumes over half of the power.

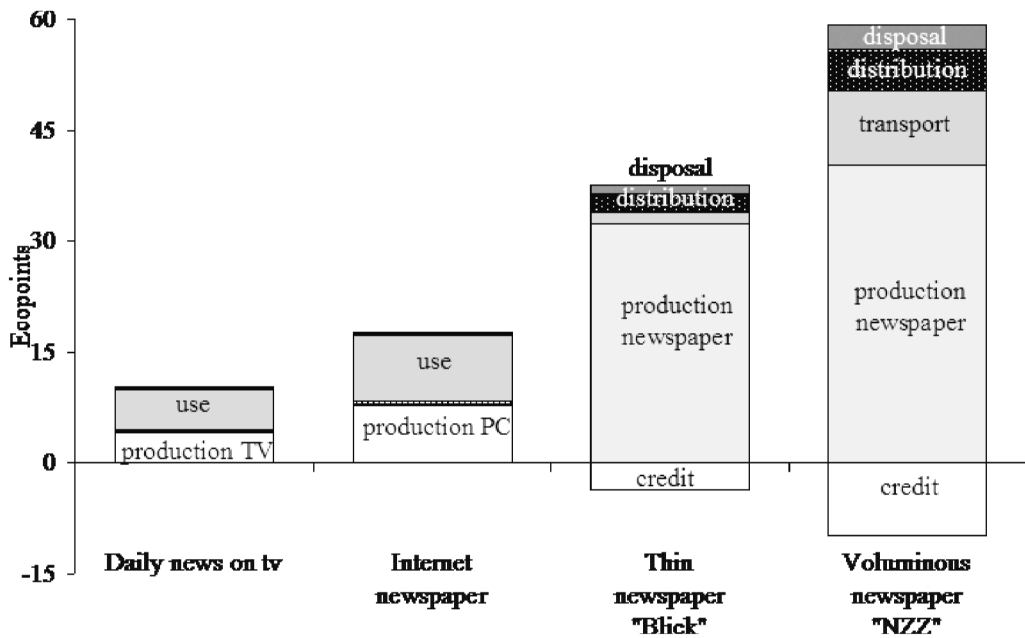


Figure 5 Environmental impact of reading or listening the daily news, disaggregated by life-cycle stages. The environmental impact is expressed in eco-points of the environmental scarcity method. The credit is for energy recovered from burning part of the waste paper which is disposed of together with household waste in incineration plants.

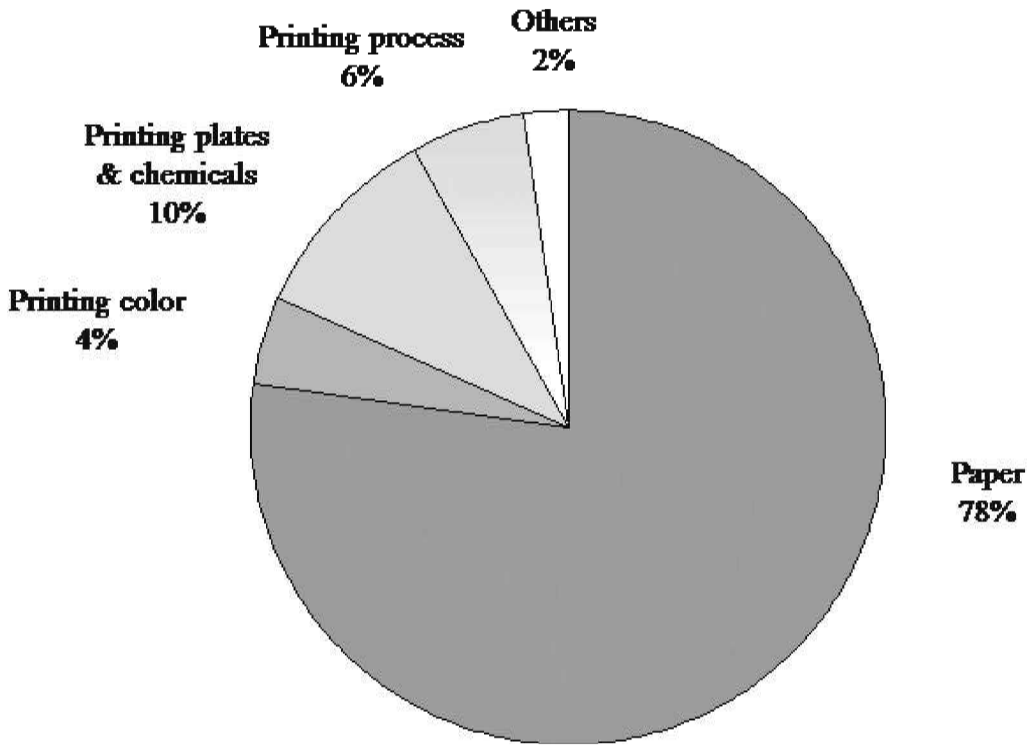


Figure 6 Environmental impact for the production phase of the newspaper life cycle. The environmental impact is expressed in the eco-points of the environmental scarcity method (100% = 40.3 eco-points).

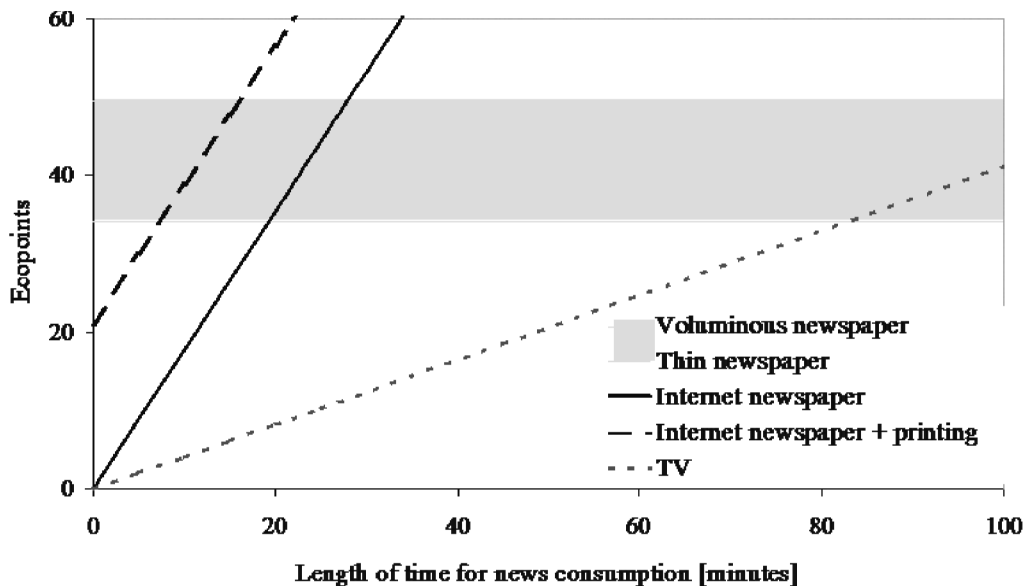


Figure 7 Influence of length of time for news consumption on the environmental impact, as determined by the environmental scarcity method.

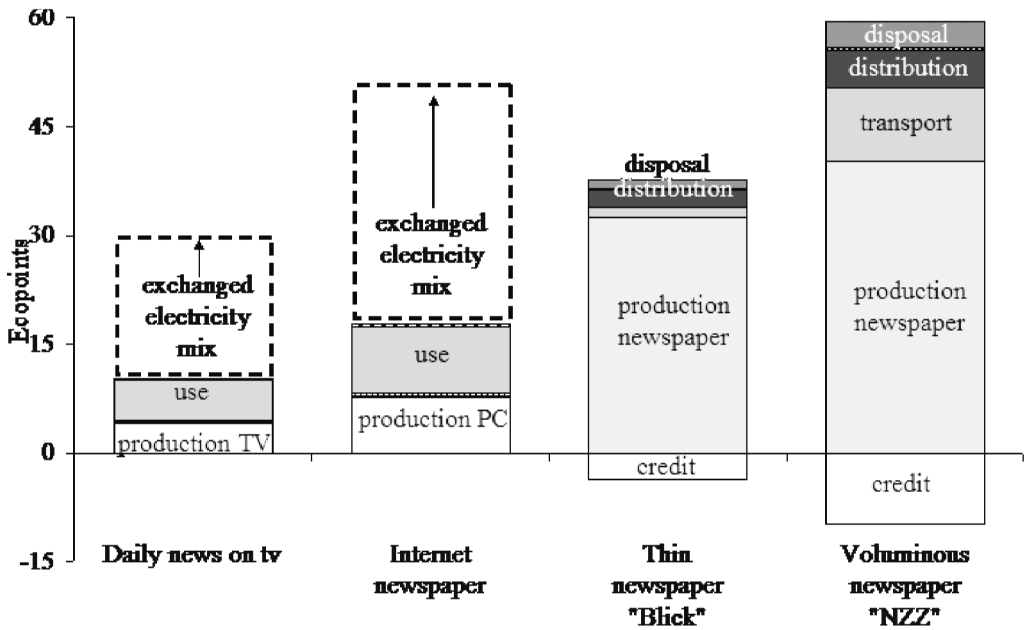


Figure 8 Influence of the electricity mix on the environmental impact as determined by the environmental scarcity method.

impact was caused by the production of the computer and the other half by Internet use itself. In the case of greater active use of a computer (as in a business context), the proportional burden of the production phase allocated to private use would be reduced. This would leave the use phase, and in particular operation of the telephone network, as the major contributor to the environmental impact. In the case of using a laptop instead of the desktop computer assumed in this study, the environmental impact would also drop because of lower power consumption.

The second functional unit, daily news, is much less based on functional equivalence because presentation of news differs substantially between media. Instead, the outcome of the compared activities is similar: a consumer who is informed about the daily news. From a consumer's point of view, there is a rough kind of equivalence. Watching TV clearly causes the least environmental impact under the conditions assumed (Swiss electricity mix during use phase). Considering that there is often more than one person watching TV, the impact per person drops even further. The environmental impact of TV watching, primarily due to electricity consump-

tion, could be further reduced during standby or by disconnecting the TV when not in use.

The environmental impact of reading an online newspaper is nearly always greater than watching TV insofar as finding the relevant news item on the Internet would already take up a lot of time and people get easily sidetracked. Reduction of the impact is possible through focused search strategies on the Web and by limiting time on the Internet (i.e., by avoiding browsing). Further reduction of the impact is possible by reducing the energy consumption of the computer itself, for example by flat-screen monitors or laptops, and also improving the energy efficiency of the telephone network and data transfer via Internet. Reduction of the impact from manufacturing per time unit used could be achieved by extending the hours of use of the computer, either over a longer lifetime or more hours per day, as with a business computer. Another way to reduce the impact may be the use of WebTV, one appliance for watching TV and surfing the Internet, thus eliminating the need for a computer altogether. Further key drivers of the impact are printing on-line information and electricity generation and consumption. Note that the envi-

ronmental impact of watching TV or surfing the Internet rose twofold when the Swiss electricity mix was replaced with the average European electricity mix, with its high percentage of fossil fuels. Thus, an option for linking electricity consumption with generation in future LCA studies under the liberalized electricity market is to model the power mix from the chosen supplier, thereby making the customer responsible for the environmental impact of his or her choice.

Reading a printed newspaper causes significant environmental impact relative to watching the TV news or reading the on-line newspaper. This is even more so the case if there is only one reader per newspaper or if a single person buys more than one newspaper.

Further Need for Research

This article presents an effort to compare services that are conspicuously incommensurate along important dimensions. Additional research could build on the foundation offered by this work to address questions such as the sensitivity of the findings to changes in system boundaries (e.g., if news acquisition by journalists is considered as part of the life cycle, and if TV, electronic, and print journalists operate differently, are the results affected?). In addition, future research might examine the impact of new technologies such as extensive household access to the Internet via broadband networks, more widespread use of laptops and mobile (handheld) devices for receiving news, TV-based Internet access (WebTV), or other advanced consumer technologies.

Studies such as this one could also be conducted much more easily with reliable LCA inventory data for the manufacturing of a computer (or a laptop, etc.). At present, very little transparent and up-to-date inventory data for electronic goods are available. Similarly, better data are needed for the pattern of usage of "standby" mode in electronic devices. Also, there are large uncertainties about the electricity consumption of the Internet and the telephone network. Unfortunately, research in these fields is heavily restricted by confidentiality agreements and lack of data. Getting any data at all about energy consumption of networks is difficult. Often large companies have little information about the

electricity consumption of their entire enterprise. The more complex the networks and the more services they offer, the more difficult it becomes for companies to know those data, much less share them.

Bottom-up case studies such as this one are a step toward knowing the direct environmental impact of the Internet and other electronic products. With more studies of this kind, it will be possible to advance knowledge of the indirect effects of the Internet. Together with top-down studies of the total energy consumption of the Internet, it will eventually be possible to estimate the environmental impact of the Internet.

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Notes

1. In the case of broadcast news, where the news item occurs at an indeterminate time in the broadcast, this could affect the use time of the TV with commensurate impacts on use-phase energy consumption.
2. While we view the exclusion of the advertising supplements as appropriate system boundaries, others might argue to include life-cycle impacts of the supplements on the grounds that this activity is central to the economic viability of the business of the newspaper.
3. As per ISO 14049, this allocation method adds up the impact for primary production and the average number of recycling cycles. Then that impact is divided by the number of cycles (in this case, 1 virgin plus 1.3 recycled).

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