

# ARE ELECTRONIC DIRECTORIES MORE ECO-EFFICIENT THAN PRINT DIRECTORIES ?

Inge Reichart<sup>1</sup>, Roland Hischier<sup>2</sup>

<sup>1</sup>EMPA St. Gallen, Lerchenfeldstrasse 5, CH-9014 St. Gallen

The success of electronic information systems in relation to traditional printed data bases is the result of easy access, convenience in handling and efficiency in time and costs. However, little is known whether electronic information systems are also more eco-efficient.

Aim of this Life Cycle Analysis (LCA) case study was a close examination of the environmental impact caused by a search for a telephone number in electronic and print directories. Question of this study is: Where are environmental hot spot located along the life cycle of the investigated media CD-ROM, teleguide — an electronic appliance in the public telephone booths, online and telephone book?

## Methods

### Life Cycle Analysis

Life Cycle Assessment (LCA) is a technique for assessing the environmental impact associated with products or services. LCAs are typically carried out in four phases:

1. It starts with the setting of goal and scope of the study. The latter consists of the definition of a reference unit, the setting of the system boundary, the setting of necessary assumptions - to state only the most important aspects.
2. Then, relevant in- and outputs of the product or service system are gathered. Data about resource consumption, emissions into air, water, and soil as well as waste is collected. Usually, this is done along the entire life cycle of a product or service, i.e. along production, use, and disposal including transportation.
3. Next step is the evaluation of the environmental impact associated with the considered in- and outputs.
4. Finally, results of the previous phases are interpreted.

In this study two internationally recognised assessment methods were applied, the Swiss method of environmental scarcity (Brand 1998) and the European Eco-Indicator 99 method (PRé 2000).

### Reference unit

The environmental impact of a single search for a phone number was determined by duration of a search and frequency. Duration of a search was determined empirically, while frequency of searches, which is used as background data, was based on statistical data for the teleguide (Swisscom 1999) and on best guess for CD-ROM and telephone book (Table 1).

Table 1. Reference unit for a single search of a telephone number

	Online	Teleguide	CD-ROM	Telephone book
Duration of search	59 seconds	55 seconds	45 seconds	irrelevant
Frequency	irrelevant	12.5 / day	2 / week	2 / week

## Product system

User of the media is the average Swiss adult, who is living in an average household. Media were specified according to this assumption and their user behaviour and life time was based on average use in Switzerland (Table 2).

Table 2. Specification of the product system

	Online	Teleguide	CD-ROM	Telephone book
Specification	<ul style="list-style-type: none"> <li>• Modern, middle class desktop computer</li> </ul>	<ul style="list-style-type: none"> <li>• Ascom Teleguide</li> </ul>	<ul style="list-style-type: none"> <li>• Swisscom CD-ROM Nr. 5/99</li> <li>• Modern, middle class desktop computer</li> </ul>	<ul style="list-style-type: none"> <li>• Average size</li> <li>• 1.5 books per household on average</li> </ul>
User behaviour	<ul style="list-style-type: none"> <li>• PC on: 2 h / d (145 W)</li> <li>• PC off: 22 h / d (0 W)</li> </ul>	<ul style="list-style-type: none"> <li>• Teleguide: see table 1</li> </ul>	<ul style="list-style-type: none"> <li>• CD-ROM: see table 1</li> <li>• PC on: 2 h / d (145 W)</li> <li>• PC off: 22 h / d (0 W)</li> </ul>	<ul style="list-style-type: none"> <li>• Phone book: see table 1</li> </ul>
Life time	<ul style="list-style-type: none"> <li>• 4 a</li> </ul>	<ul style="list-style-type: none"> <li>• 7 a</li> </ul>	<ul style="list-style-type: none"> <li>• 0.5 a / CD-ROM</li> <li>• 4 a / PC</li> </ul>	<ul style="list-style-type: none"> <li>• 1.25 a</li> </ul>

## System boundary

Media are investigated along their entire product life including transportation. The operation of necessary infrastructure, like data transfer in the internet, operation of the telephone network and the electronic telephone directory is also taken into account.

Power consumption during the life cycle of media was linked to the relevant national electricity mix, depending on location of use. In the case of print media production this is the Scandinavian, German, or Swiss national electricity mix. In the case of electronic media production it is the average European electricity mix. For use phase it is the Swiss electricity mix, because use of media is supposed to take place in Switzerland.

## Results and Discussion

The environmental impact of a search in the telephone book or the CD-ROM is bigger compared to an online quest or a search via teleguide, at the assumed low frequent use. Application of the method of environmental scarcity (Figure 1) and the Eco-Indicator 99 (Figure 2) lead to similar results, except for the CD-ROM, which gets a higher environmental burden when applying the Eco-Indicator 99.

There are two reasons for the high environmental burden of the telephone book and the CD-ROM. *First of all*, it is the energy-intensive production of paper and board for the packaging and the manual of the CD-ROM as well as the phone book. About a third of the environmental burden of the CD-ROM can be reduced by leaving away the cardboard box and replacing the printed manual by an electronic file. *Second* aspect is the low frequent use, because frequency is the factor by which total environmental impact of a phone book and a CD-ROM are divided.

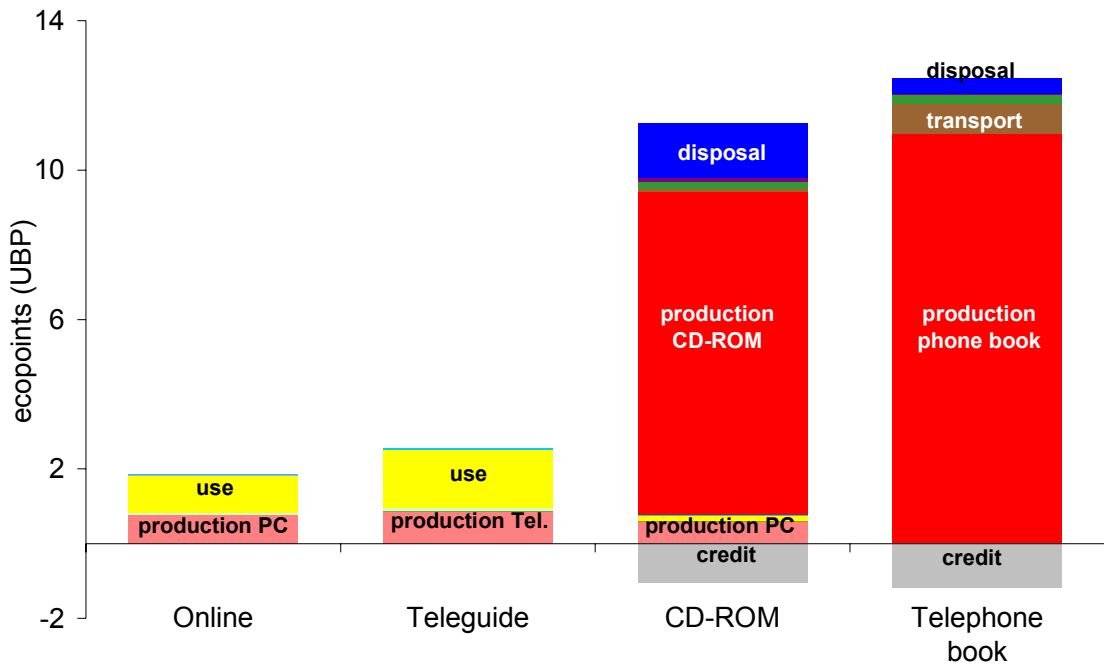


Figure 1: Environmental impact (environmental scarcity method ) of a search for a phone number.

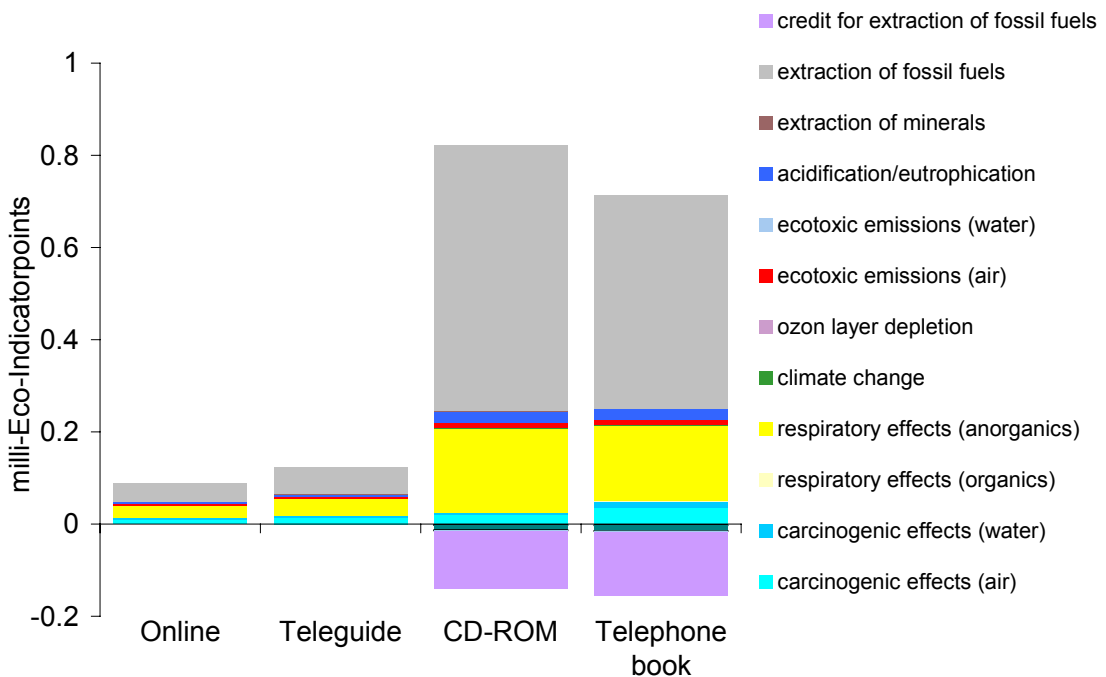


Figure 2: Environmental impact (Eco-Indicator 99 method) of a search for a phone number.

The influence of user frequency on the result was tested in a sensitivity analysis (Figure 3). If search frequency rises up and beyond eight times a week the environmental impact of all media is the same. The previously seen difference of the phone book and CD-ROM in relation to online and teleguide disappears. The environmental impact of the teleguide remains the same, because a change in the individual user behaviour has only marginal effect on the public user behaviour of the teleguide. In the case of an online quest a change in user frequency also has only marginal effect on the user behaviour of the computer in general.

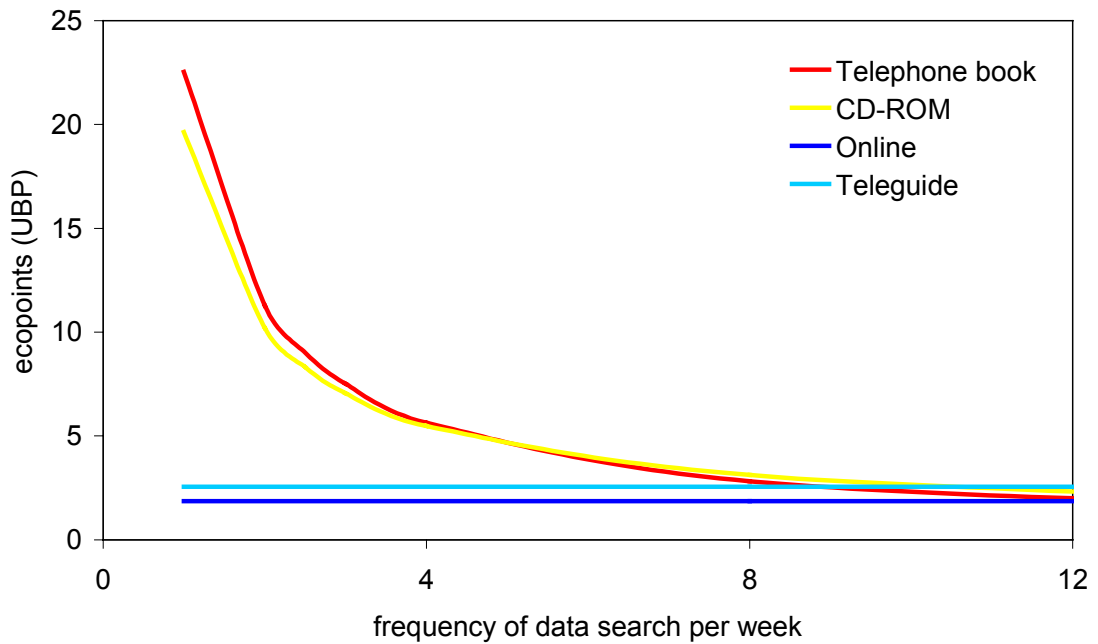


Figure 3: Influence of frequency on the environmental impact of a search.

As the environmental impact of online and teleguide search get more important at higher frequencies a closer look at both media gets necessary. The slightly dominating environmental impact of use phase is caused in both cases only by power consumption. Important contributors to that impact are the teleguide especially during stand-by, internet data transfer and operation of the telephone network (Figure 4).

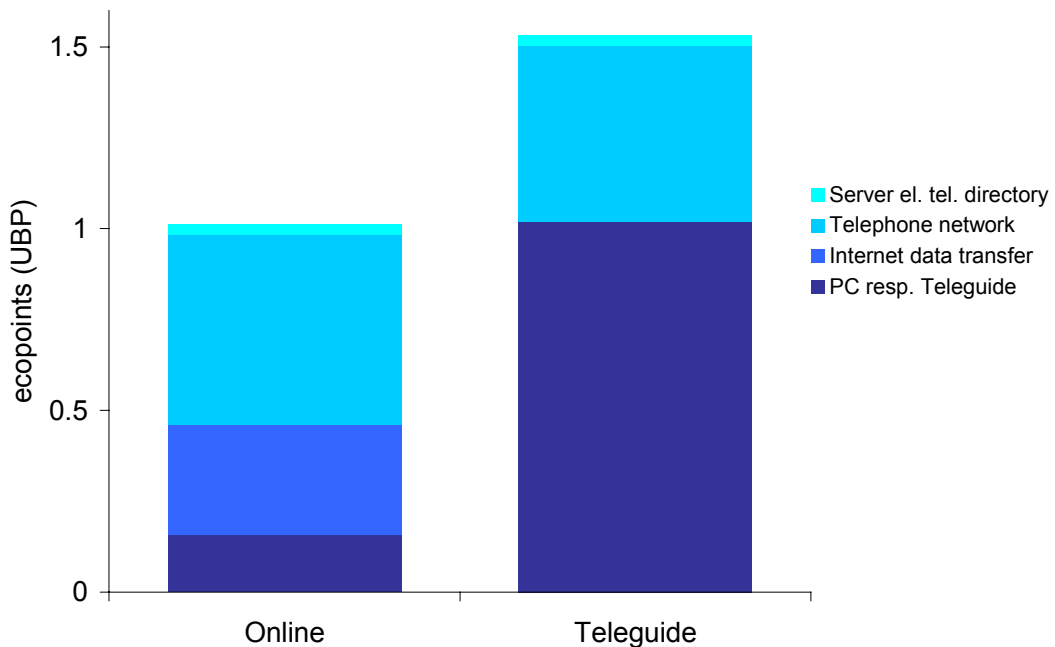


Figure 4: Detail: Environmental impact during use phase of an online or teleguide search.

In reality, results of a search in an online or CD-ROM directory are frequently printed. An extra seven ecopoints have to be added for every page of office paper printed, mostly

because of the energy-intensive way of producing paper (Figure 5). Printing itself causes little environmental impact.

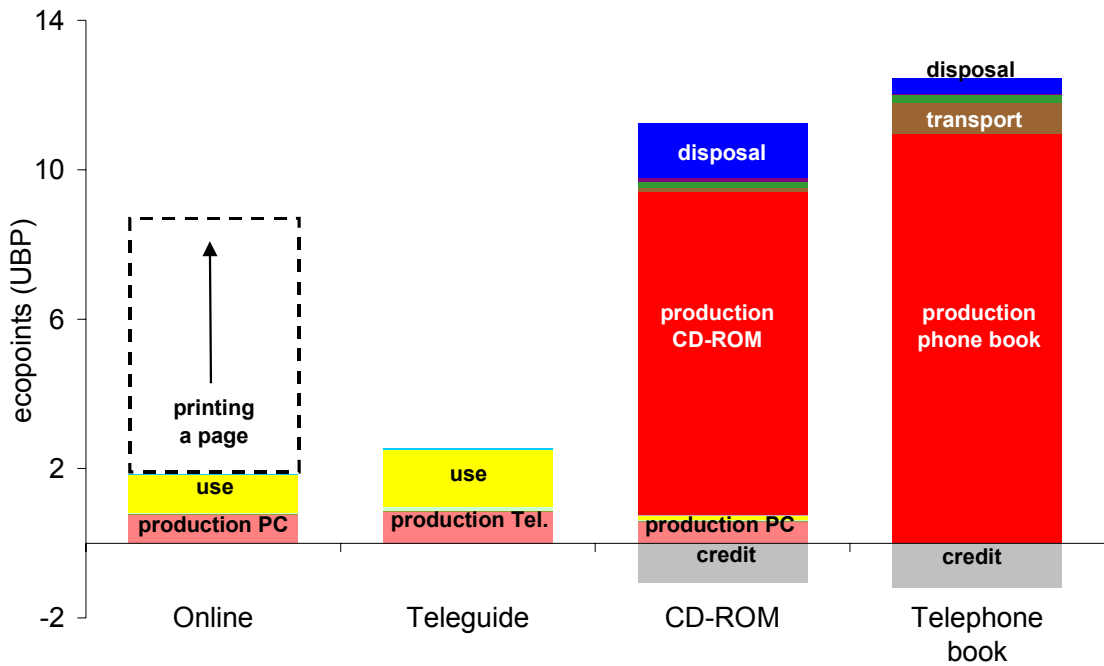


Figure 5: Influence of printing a page on the environmental impact of a search.

Location of media use was tested in a further sensitivity analysis. This was achieved by replacing the underlying electricity mix for the operation of (electronic) media. The replacement of the Swiss electricity mix with the average European electricity mix represents use of media somewhere in Europe instead of Switzerland. Results are shown again for a search frequency of twice a week for the telephone book and CD-ROM and twelve times a day for the teleguide (Figure 6).

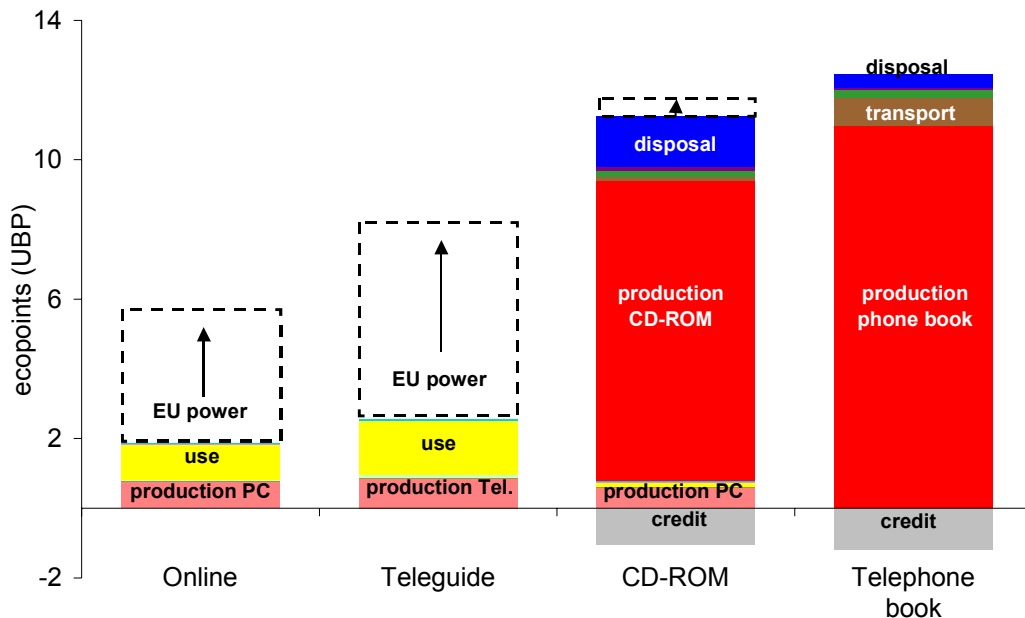


Figure 6: Influence of the assumed electricity mix during use phase of media on the environmental impact of a search.

The increase of the environmental impact resulting from the replacement of the electricity mix is shown as the dashed box. The environmental impact of the CD-ROM rises only slightly, because power consumption of the PC is not the dominant part in this case. In contrast to that, the environmental impact of the teleguide and the online search triples. This brings the teleguide into the same range of the environmental impact as the CD-ROM or the telephone book.

## Conclusion

Electronic media offer only little environmental advantage compared to print media when comparing them under the aspect of information retrieval from a (telephone) directory or catalogue. Online quest and teleguide search cause less environmental impact than the telephone book, if:

1. The directory is used at low frequencies, which is typically the case for private use.
2. Results of the search are not printed.
3. Electricity consumed during use phase is generated from a large amount of renewable energy sources.

CD-ROM, as another electronic media, does not offer the same environmental advantage at low frequent use, but only at high frequent use or even in a network with extremely frequent use. To put it the other way, the environmental impact depends on the way the information is stored. Decentralised ways of data storage like the telephone book and the CD-ROM lead to more environmental impact at least at low frequent use than centralised ways of data storage, like the teleguide or online directory.

Recommendations for action can be looked up in the final report (Reichart 2001).

## Acknowledgements

This study has been funded by the Commission of Technology and Innovation (CH), the association for the promotion of research in graphic arts industry/ugra (CH), Swisscom (CH), Neue Zürcher Zeitung (CH) and Ringier (CH). The authors also want to thank Mr. M. Zurkirch (Swisscom, Bern) and Mr. H. Schefer (EMPA, St. Gallen) for their excellent work in the project team.

## References

- Brand G., Braunschweig A., Scheidegger A., Schwank O. (1997): Bewertung in Ökobilanzen mit der Methode der ökologischen Knappheit - Ökofaktoren 1997. In: Bundesamt für Umwelt, Wald und Landschaft (BUWAL), Schriftenreihe Umwelt Nr. 297, Bern
- PRé (2000): The Eco-indicator 99. A damage oriented method for Life Cycle Impact Assessment. Methodology Report. Electronically published under URL: <http://www.pre.nl>
- Reichart I., Hischer R. (2001): Vergleich der Umweltbelastungen bei Benutzung elektronischer und gedruckter Medien. ugra/EMPA, St. Gallen, 2001
- Swisscom (1999): Teleguide. Electronically published under URL: <http://www.swisscom.ch/gd/products/products-de.html>, December 1999