13th Discussionforum LCA / 13. Diskussionsforum Oekobilanzen

Environmental Impacts of Telecommunication Systems and Services

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Abstracts and Summaries

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Material Input per Unit Service (MIPS) of the Italian Mobile Telephone Network

Dr. Fabio Musmeci, Antonio Federico & Daniela Proietti Mancini, ENEA Casaccia

The material flow in our economy is a measure of the human pressure on the environment. The Material Input per Unit Service (MIPS) is an index of such pressure that can be computed for different products or services. Products, services and infrastructures must be compared and designed from the beginning under the aspect of ecological criteria of resource efficiency.

A survey has been carried out on the material requirement for offering the mobile telephone service in Italy. The T28 Ericsson mobile telephone has been analyzed as typical device. A 75 kg ecological rucksack has been found for the telephone. This takes into account the production, transportation and use for one year. Transport has shown not very important in this computation. Taking into account the network structure, especially considering the Radio Base Station building phase and its energy consumption and maintenance during operation, an hidden flow of 2.416 million tons a year is required by the network to operate. Considering the 41.4 millions Italian subscribers, this gives 183.85 kg/user. The rucksack of the mobile telephone of the network are of the same order of magnitude. As service units we consider both the minutes of telephone calls and the number of SMS messages. This gives an estimated MIPS of 0.207 kg/(minute of telephone call) and 0.632 kg/SMS. If we assume one SMS is the substitute of 10 sec of telephone call then a final MIPS of 0.196 kg/minute can be calculated.

Yield losses in electronics production are significant to LCA

Gabor Doka, Zurich

Often in LCAs of electronic products and components the direct material demand of the product is assessed by looking at the materials remaining in the final product (eg. Reichart and Hischier 2001, Soldera 1995, Hofstetter 1989, IZT 1998). This shortcut inventory procedure gives a fairly good assessment *if* waste rates in production are low, i.e. most of a material input into production will end up in the product. However, in electronics production this assumption does often not hold true The reject or fail rate in the quality control step of electronic component production is notoriously high. Due to the highly progressive electronics market situation with ever shorter production cycles there is often an increasing lack of time to optimize component production and minmise fail rates.

With respect to these special circumstances the often encountered inventory procedure of assessing what materials remain in the product needs to be reconsidered for LCAs of electronic products and components. Electronics infrastructure might be environmentally more important than current studies suggest.

#. Hofstetter, Patrick 1989 Theorie und Anwendung der Oekobilanz am Beispiel von Glueh- und Energiesparlampen. Semesterarbeit Gruppe ESU, ETH Zurich
#. IZT (S.Behrendt, R.Freibich, S.Lundie et al.) 1998 *Oekobilanzierung komplexer Elektronikprodukte*

IZT, Springer
#. Reichart, I. & R. Hischier 2001 'Elektronische Medien versus Printmedien - Oekologische Auswirkungen der Mediennutzung'. EMPA St. Gallen, to be published
#. Soldera M. 1995 'Oeko-computer - Vergleich eines Oeko-PC mit einem herkoemmlichen PC anhand Lebenszyklusanalysen LCA'

Life Cycle Inventory Results for the Cordless Phone Gigaset 2010

Dipl.-Ing. Martin Schäfer, Siemens AG & Dr. Robert Arenz, T-Systems, debis Systemhaus, Competence Center EDM

Among consumers the popularity of cordless phones – similar to mobile phones – is increasing rapidly. Therefore it is getting ever more important – especially for Siemens as manufacturer of such products – to estimate the environmental impacts of cordless phones and to develop environmentally sound Gigaset-generations in the future. Therefore an inventory analysis and a weak point analysis for Gigaset 2010 has been realized. In the presentation some exemplary results will be introduced. Furthermore a closer look will be taken into the usage life-cycle phase.

Importance of system borders and scenario assumptions in the evaluation of new media technologies

Mireille Faist & Prof. Susanne Kytzia, Regionaler Stoffhaushalt, EAWAG & ETH Zurich

New information technology influences our lifestyle; does the latter become then more sustainable? Evaluations of new technologies often fail to give a clear-cut answer. A problem of such evaluations is to define functional unit and system borders as the studied systems are mostly multi-functional. Let's examine two examples: Internet newspapers should allow saving paper and therefore energy; telecommuting should save energy of transport and office space heating. However, depending on what is compared with its Internet equivalent – a single article or a whole newspaper – the result can favor one or the other option. For the assessment of telecommuting, the significant assumption is to what extent office space can be reduced. But also important is the social aspect of work: to what extent will telecommuters compensate their social isolation with higher mobility in their free time? The question is then: do we just increase consumption with these new technologies? And how can an evaluation capture these questions?

E-commerce – an opportunity or a threat for LCA and sustainable development?

Gerald Rebitzer & Prof. David Hunkeler, EPFL - LPBM

E-commerce, based on the rapid development of the World Wide Web, is challenging and changing industrial practices in many business sectors around the world. Though the involved information and communication technologies as well as the emerging business operations of the new economy are rather "clean", the resulting globalization leads to new patterns of production, distribution, and consumption. Often the possibility to act on the whole world as a market for purchasing and selling goods and services leads to new and increased transports and other "old economy" activities and thus to additional resource consumption and environmental impacts. Additionally, shifts in production locations from highly developed to second and third world countries occur.

These issues siginficantly affect sustainable development and also the way we try to measure its success. One has to raise the question if changing consumer behaviour and business patterns have to be integrated in environmental assessments in a much broader way than being practiced today. E.g., changing needs or rather desires of the consumer might make it necessary to compare systems with different functional units (but fulfilling similar desires). Also it might likely be that LCA without the integration of socio-economic aspects is not the suitable tool to contribute to sustainable development in the new ecocomy.

The proposed presentation is meant to be a reflection of current trends in e-commerce relevant for the environment and the (possible) implications for applying LCA in this sector of the economy.

Potentials of LCA for Environmental Management Systems in the

Semiconductor industry

Dipl.Ing. Michael Spielmann, UNS ETH Zurich & Fraunhofer IZM, Berlin

The strict division of labour generates a complex logistic network in which environmental interventions occur at various steps in the production chain. The responsibility for the finished product towards the customers, however, remains undiminished. Based on these findings, it has been concluded that a strongly product-oriented EMS is required. Also, in order to improve and control the selection of materials as well as the environmental performance throughout the entire production chain, LCA may be an essential part of the EMS in order to answer the following questions:

- Which are the most significant environmental aspects with respect to both the company's activities as well as their products?
- Which objectives, targets and measures for the EMS are necessary to improve the environmental performance within the production chain?
- What are the most important elements of an EMS inside a logistical network for semiconductor production?

LCA of complex systems: examples from the domain of telematics and transport

Dr. Pierre Rossel, Project ESST, EPFL

Not an object, a process, a material nor a flow of a particular kind, complex systems are sets of combinations of all that and their ecobalance is therefore particularly difficult to establish in a robust manner.

Our reflection has, as an origin, the analysis of the various ecobalance studies carried out in regards with the Swissmetro maglev technology, including the identification of serious limitations such as: heterogeneity of sources, relevant domains and measuring units, local or temporary dramatic course of events, always difficult to introduce in the picture, external dimensions, critical yet nearly impossible to frame in, induction effects and cross-interfering with the ecobalance of other transports modes, and in general a severe deficit of standardisation which could make possible comparison or complementarity of the obtained results in a wider ecobalance agenda.

Telematics and transport intertwine quite in similar critical paths and patterns. If, among the twelve-or-so categories of applications we typically deal with (for several dozens of actual sorts of different services), we choose as example a trendy development such as the telematics used to make motorised traffic more fluid, we can indeed identify an interesting series of problems to be overcome:

- success = solution (traffic more fluid), but also trafic induction towards new congestion horizons;
- co-related effects, either directs (on traffic in general and on safety) and external (on health, risk assessment and management, noise, pollution) which fits to our heterogeneity-featuring issue;
- real-cost and financing, translating the expected favourable ecobalance into both feasible investment and efficient payment schemes
- learning potential (through statistics, behaviour and mobility-chain modifications, new policy and later public investment adjustment)
- macro evaluation and comparison, with benchmarking, hubbing, differentiation and complementarity re-design.

Altogether, ecobalance of such complex system is about assessing with robust yardsticks and reference frameworks, a dynamic process and its potential consequences, according to various possible scenarios, each one influencing to a certain extent the ecobalance of any other existing modal systems.

Environmental impacts of the EPFL internet network

Prof. O. Jolliet, GECOS, EPFL

The infrastructure which supports a university's use of the internet has been comprehensively assessed using two methods of Life Cycle Assessment.

Part I: process LCA

A process-level study (fig.5) focusing on the direct as well as indirect ("embodied") energy input requirements of the total physical infrastructure has been performed, including various scenarios for near-term technology changes in equipment and software.

The Internet infrastructure of the Swiss federal Institute of technology (EPFL) is composed of 7000 PC, 400 printer printing 9 million pages per year, together with 90 switches, 68 servers, 22 routers and 121 km cable (fig.6). Non renewable primary energy is calculated, showing that the PCs (control units and screens) are dominating the energy use, while the 90 switches play a significant role (fig.7). In the future, the foreseable use of flat screens and the move from desktops to notebooks would contribute to reduce the energy consumption by 50%. The use phase play a dominant role for conventional PC, but the embodied energy consumption during PC production play a higher role for notebooks or flat screens (fig.8).

Part II: Input-Output LCA and Cost of ownership

An input/output-based LCA of the system (fig.9) has also been performed and compared with the process-level results. Figure 11 shows that for the CO2 emissions, input output LCA and processed LCA indicate similar share between the different components of the EPFL network. The more comprehensive Input-Output (but coarse) LCA shows that priorities for environmental improvement change considerably when environmental impacts other than energy, such as toxic releases, are taken into account (figure 12: printers play a dominant role for VOC). The CO2 and VOCs emissions linked to the amount of 700000 US$/year paid by EPFL to be connected on the worldwide Internet network are rather negligible.

The analysis further expands the boundaries by considering the environmental burdens of non-hardware input requirements, such as software, training, management, trouble-shooting – the "Total cost of ownership" for the personal computer portion of the system (fig.13). These costs of ownership are indeed dominating the overall expenses related to the EPFL PC network (fig.14) and the corresponding emissions are significant (fig. 15 and 16). Results from the expanded scope analysis demonstrate that ownership cost improvements such as increased operating system stability can significantly reduce both cost and the total environmental footprint of the infrastructure supporting the internet.

POSTER only: Sustainability of new work practises and building concepts

Prof. Dr. Niklaus Kohler, IFIB, Karlsuhe University

New forms of communication and co-operation do not have the same environmental impact pattern as current forms of work. Environmental impacts are produced by work technologies (mainly communication technologies), buildings (construction, maintenance, operation and destruction) and transport (induced by work relations and housing). The thesis that new information technologies reduce transport and building energy consumption has not been verified in practice until now. The contribution discusses the interrelation between different impacts, gives quantitative data of environmental impact based on the combination of existing life cycle analysis and tries to estimate possible future developments. The question of the necessity of new buildings and the possible development of virtual buildings is discussed in relation with sustainable development

It has been published in :

- Streitz, N. et al. (Eds.), Cooperative Buildings - Integrating Information,
- Organization, and Architecture. Proceedings of the First International Workshop on Cooperative Buildings (CoBuild '98) February 25-26, 1998, Darmstadt. Lecture Notes in Computer Science. Heidelberg 1998.