

Energy- and Eco-Efficiency of Data Centres

- 1) **Creation date of the summary:** 26.08.2015

- 2) **Record ID:** 8395

- 3) **Last update:** 11.07.2011

- 4) **Project status:** Completed (01.05.2001 - 31.12.2010)

- 5) **Organizational unit:** Departement Management, Technologie und Ökonomie, Rutherford, Thomas F., , LZ=03797

- 6) **Project leader(s):**
 - Aebischer, Bernard, baebischer@retired.ethz.ch

- 7) **ETH researcher(s):** no entry

- 8) **External researcher(s):**
 - Frischknecht, Rolf, frischknecht@esu-services.ch
 - Huser, Alois, alois.huser@encontrol.ch
 - Varone, Frédéric, varone@spri.ucl.ac.be

- 9) **Funding source(s):**
 - Public institutions (e. g. federal offices)

- 10) **Partner organizations:**

Amstein und Walthert AG, Andreasstrasse 11, 8050, Zürich, Switzerland, Tel 0041 1 305 91 11, Fax 0041 1 305 92 14, info@amstein-walthert.ch, www.amstein-walthert.ch

Encontrol GmbH, 5443, Niederrohrdorf, Switzerland, www.encontrol.ch

ESU Services, Kanzleistrasse 4, 8610, Uster, Switzerland, http://www.esu-services.ch/

Institut de hautes études en administration publique - IDHEAP, Route de la Maladière 21, 1022, Chavannes-près-Renen, Switzerland, Tel 0041 21 694 06 00, Fax 0041 21 694 06 09, idheap@idheap.unil.ch, http://www.idheap.ch/

Université Catholique de Louvain, Place de l'Université 1, 1348, Louvain-la-Neuve, Belgium, www.ucl.ac.be

11) Short Summary: In this study we investigate strategies and technical approaches to foster more energy-efficient and environmentally sound planning, building, and operating of data centres. We also formulate policy recommendations on how to integrate the findings into the legal and regulatory framework.

12) Keywords: Economics, Engineering Sciences, Environmental Sciences, Information Science

13) Project description:

Approach and methodology

Energy-economic and policy aspects of these three issues are studied. The energy analysis is focused on data centres and similar activities in the ICT-sector, but the outcomes relative to the central infrastructure of the buildings are valid for all kinds of high electric load buildings. The policy analysis takes a more general approach and the findings can be applied to all large energy consumers.

Energy efficiency in data centres

In the absence of an adequate indicator for the service delivered by data centres, energy efficiency is measured by the coefficient of energy efficiency (CEE), a two-step measure of the fraction of the "useful" energy:

$CEE = C1 * c2 = (U / T) * (u / U)$, with

T ... total electricity consumption of data centre

U ... total el. consumption of ICT-equipment

u ... "useful" el. consumption of ICT-equipment

Policies to foster energy efficiency in data centres: Existing voluntary approaches - "Energiemodell

Zürich” and the ”Energiemodell Schweiz” - are evaluated. This approach, ”voluntary agreement on target values”, is compared to the actual situation in Geneva that concentrates more on the procedure to be followed. It is also compared to other scenarios characterised by a higher degree of intervention.

Results

The detailed analysis of the technical-economic feasibility showed that C1, the first component of CEE, is a good choice to describe the energy efficiency of a data centres central infrastructure. It can be used in the construction-permission process and in the follow-up monitoring process. The second component of CEE, C2 measuring inefficiencies in the ICT equipment, can be used to monitor the inefficiencies in the ICT equipment. But the uncertainties are still too important to use C2 as an indicator leading to a target value or even a constraining standard.

Voluntary policy is the essence of scenario S2. It fits well in the actual policy ”environment” in Switzerland (cf. voluntary agreements for CO2 reduction) and in the initiated legislative reforms in Geneva, and can be implemented immediately. More constraining policies (S3, S4) are investigated regarding the central infrastructure. A comparison shows an obvious advantage of S3 and S4 regarding effectiveness, but the political obstacles and the time needed to prepare and implement these policies are probably rather important. Furthermore, additional administrative resources as well as a cultural change within the ScanE are pre-conditions for more constraining policies.

The conclusions of the policy analysis are not restricted to ICT companies. The different scenarios can be applied to all important energy consumers in all economic sectors - provided that adequate indicators for energy efficiency can be defined and determined.

Seventeen recommendations grouped in four topics are formulated. These topics are:

- Transfer of the accord into an institutionalised legal and regulatory framework
- Energy-efficiency policies for all large energy consumers
- Preconditions, pre-requisites
- Operational design of voluntary energy policies

In a final outlook it is recalled that the future electricity demand of data centres is uncertain, but that electricity demand will grow substantially for ICT in general. Nevertheless, electricity for ICT will remain in the coming years a small fraction of total energy and electricity consumption in Geneva. In order to reach the goals set by the energy policy in Geneva, it is most important to involve all economic activities and all energy-consuming processes and equipment in a process aimed at a more energy-efficient economy.

These findings were published in Aebischer et al. (2003).

On behalf of the Canton of Geneva an update of this report was done in 2007: Aebischer (2007). A metering concept was elaborated in 2008 by Maucoronel and Willers (2008). The definition of the

indicator C1 to measure the efficiency of the infrastructure and the metering concept were proposed to be used by the Code of Conduct for Data Centers, a project initiated by the European Commission: http://re.jrc.ec.europa.eu/energyefficiency/html/standby_initiative_data%20centers.htm
The efficiency indicator was taken over with a new name: DCiE (Data Center Infrastructure Efficiency). The Code of Conduct does not yet have a measurement concept.

14) Popular description: no entry

15) Graphics: no entry

16) Publications:

- Aebischer B. 2007-09-30. Quoi de neuf dans le domaine de l'efficacité énergétique des data centres?, Eléments d'actualisation du rapport relatif à l'efficacité énergétique des data centres commandé par le ScanE en 2001 (Aebischer et al., 2003). CEPE, ETH Zürich, Zürich.

- Aebischer, B., Balmer, M.A., Kinney, S., Le Strat, P., Shibata, Y., Varone, F. 2003-05-31. Energy efficiency indicators for high electric-load buildings, Time to turn down energy demand - Energy intelligent solutions for climate, security and sustainable development. Proceedings ECEEE 2003 Summer Study, St Raphael/France.

- Aebischer B., Eubank H., Tschudi W. 2004-03-31. Energy Efficiency Indicators for Data Centers. Proceedings of the International Conference on "Improving Energy Efficiency in Commercial Buildings, IEECB'04", IEECB, Frankfurt.

- Aebischer, B., Frischknecht, R., Genoud, Ch., Huser, A., Varone, F. 2002-12-31. Energy- and Eco-Efficiency of Data Centres, A study commissioned by DIAE / ScanE of the Canton of Geneva. Geneva.

- Aebischer, B., Frischknecht, R., Genoud, Ch., Huser, A., Varone, F. 2002-04-30. Energy Efficiency Indicator for High Electric-Load Buildings, The Case of Data Centres. Proceedings of the IEECB 2002. 2nd International Conference on Improving Electricity Efficiency in Commercial Buildings, Nice, France, Ademe.

- Eubank H., Aebischer B., Lewis M. et al. 2004-03-31. High Performance Data Centers. Proceedings of the International Conference on "Improving Energy Efficiency in Commercial Buildings IEECB'04", IEECB, Frankfurt.

17) Links to important web pages:

-