

Green IT projects in Switzerland. Measurement concept and user groups.

Dr. Bernard Aebischer, CEPE/ETH Zürich

Forum „green IT World“, CeBIT, Hannover, 6. 3. 2009



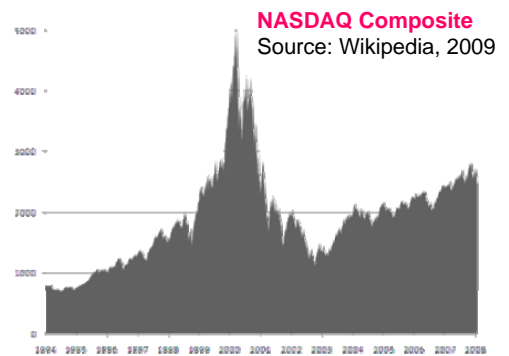
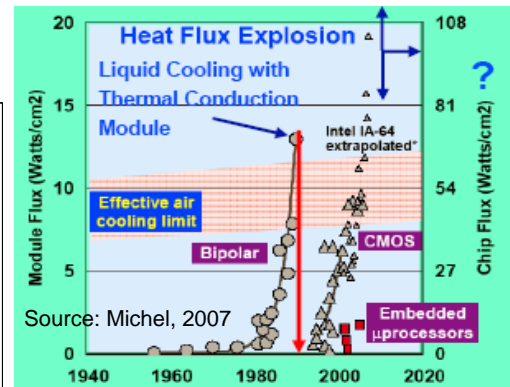
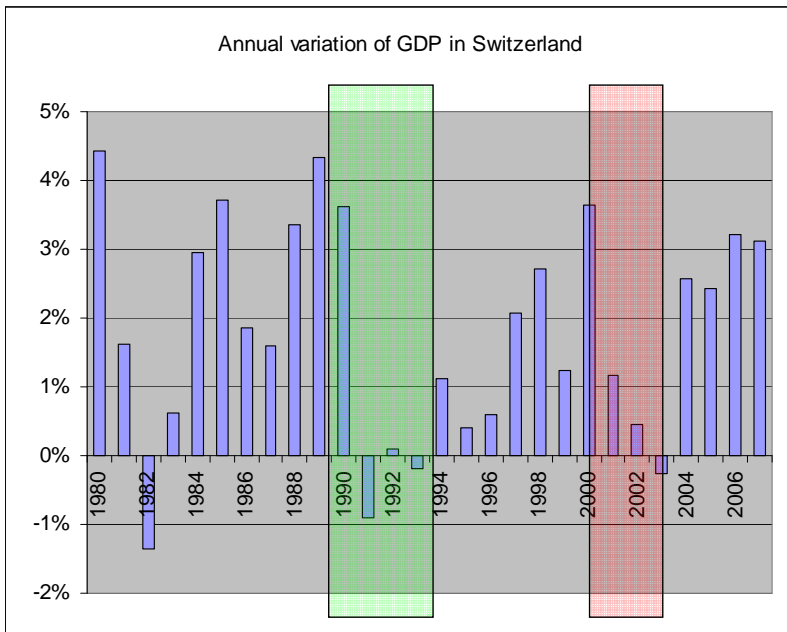
Overview/Summary

History

- 1985-1995: taming of main frame computers by new technologies
- 1995-2005: dotcom bubble interrupts fast growth of server farms
- 2005- : “green IT”

Measurement concept

User groups



History: 1985-1995

Fast increase of electricity demand by large computer centres in the financial sector (1985-1990)

Energy analysis at ETH Zürich

- Power flow in large computer centres (Spreng/Aebischer, 1990)

Formation program RAVEL (1992, p. 67)

- Free cooling, modular design, inlet temperature, metering

User group (ERFA RZ)

- Benchmarking of energy efficiency of infrastructure:

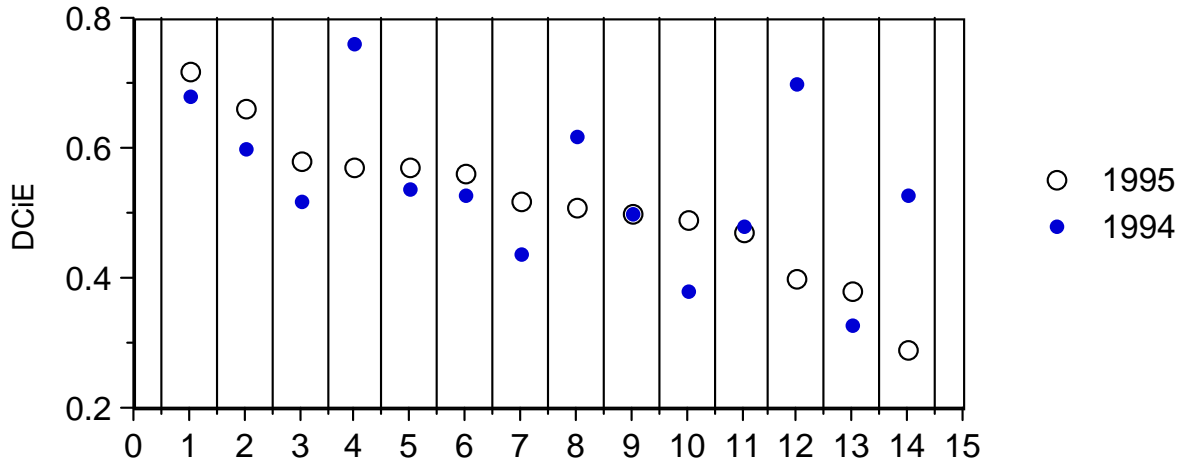
$$K = (\text{el. power IT rooms}) / (\text{total el. power}) = C1 = DCiE = 1/PUE$$

Technology breakthrough (CMOS, architecture, software)

- Decrease of electricity demand in large computer centres (1990-1995)
- → Other priorities!

K = C1 = DCiE = 1/PUE is a good indicator

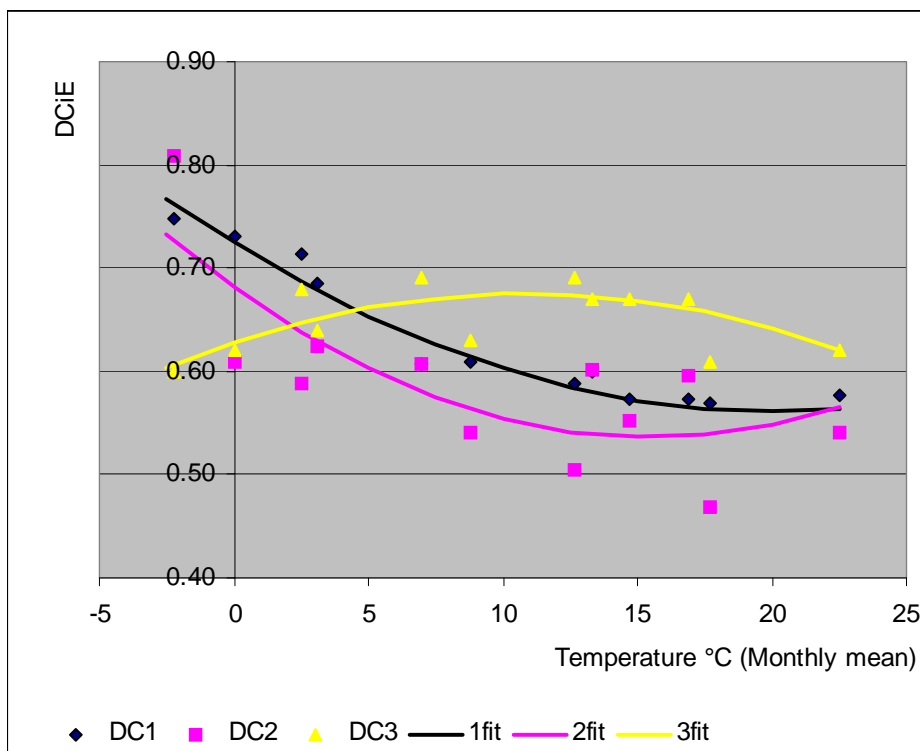
... but a good enough **measurement concept** – **with energy and not power to be measured** - is essential



DCiE in 1994 and 1995 in 14 computer centres in Switzerland

Source: Bänninger (1996) in Aebischer (1996)

DCiE (energy) in function of outdoor temperature



Source:

Swiss DCEE
Group, 2007;

Bänninger, 2007

History: 1995-2005

Diffusion of use and applications of Internet → server farms, collocation sites

Projects with locally potential huge increases of power and energy demand

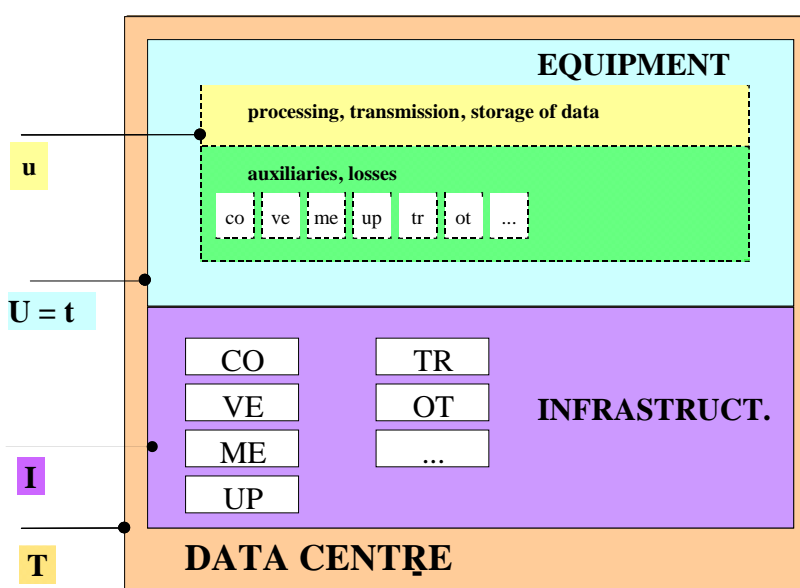
- Geneva: +(10-20)% of total electricity demand.
Study: indicators and target values for energy efficiency in data centres → voluntary agreements or legal requirements (Aebischer et al. 2003)

Case study of efficiency improvements in existing data centre: (Altenburger, 2004)

Dotcom bubble bursts after 2000

- Geneva: very little built → other priorities!

Efficiency indicators for Geneva: $CEE = C1 * c2$



Indicator for over-all energy efficiency:

$$CEE = u/T$$

$$= U/T * u/t$$

$$= C1 * c2$$

- C1 = indicator for energy efficiency of central infrastr. = **DCiE**

- c2 = indicator for energy efficiency of infrastructure of ICT-equipment : **nok**

Data flow increases faster than technical progress → new data centre capacities

Oil price increase → electricity price

W/m² increase → problems heat evacuation (no technological breakthrough in view)

Climate change discussion

→ worldwide “green IT initiatives”

Geneva goes towards “standard” for data centres

- Benchmarking to define minimal requirement for DCiE
- Standardised measurement concept needed

ERFA RZ → policy process: SwissEnergy Programme

Swiss DCEE (data centre energy efficiency) Group

- Shares information
- elaborates tools (e.g. „Stromeffiziente Rechenzentren durch Sensibilisierung über eine transparente Kostenrechnung“ with support of SFOE)
- makes assessments (e.g. new data centre of the city of Zurich)

SWKI (Swiss Society of Heating and Air-Conditioning Engineers): adaptation of ASHRAE recommendations for data centres (temperature and humidity)

Demonstration: 100% free cooling in telecommunications centres (Singy, 2005)

Measurement concept for DCiE

- Energy consumption
- Well defined measurement points

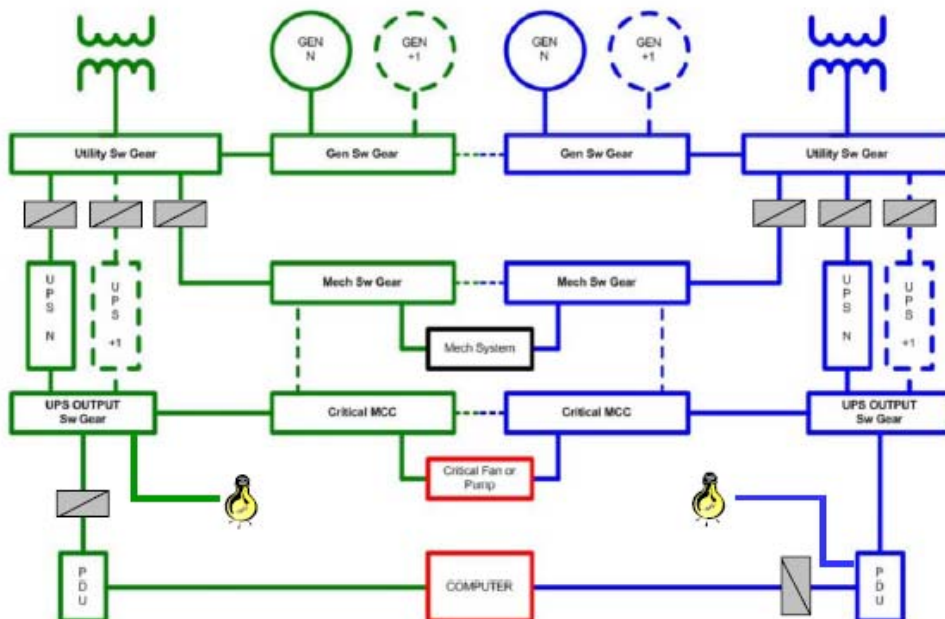
Following two characteristics of data centres:

1. Reliability: Tier levels I – IV defined by Uptime Institute
2. Cooling by equipment
 - dedicated to data centre
 - used for the whole (office) building

→ Maucoronel et al., 2008

http://www.biblioite.ethz.ch/downloads/Measurement-concept_DCiE_10-2-09.pdf

Measurement concept for Tier IV with dedicated cooling



Source:
Uptime Institute,
2006
and
Maucoronel et al.,
2008

Figure 4 : principe de mesure avec production de froid dédiée et 2 variantes éclairage

Frequency of read out and reporting

Automatic read-out:

- read out locally or from distance
- frequency no problem (except amount of data)
- electronic data base

Read-out by hand (low investment costs):

- read out at least once a month (at least monthly data points needed for analysis)
- reported in tables

User groups (active)

ERFA RZ participating in Swiss policy projects:

- Grossverbrauchermodell (Canton of Zürich)
- Energie-Modell Schweiz (Switzerland)

Voluntary agreements between cantonal/federal governments and large companies to reduce energy consumption and CO₂-emissions by well defined measures – e.g. in data centres.

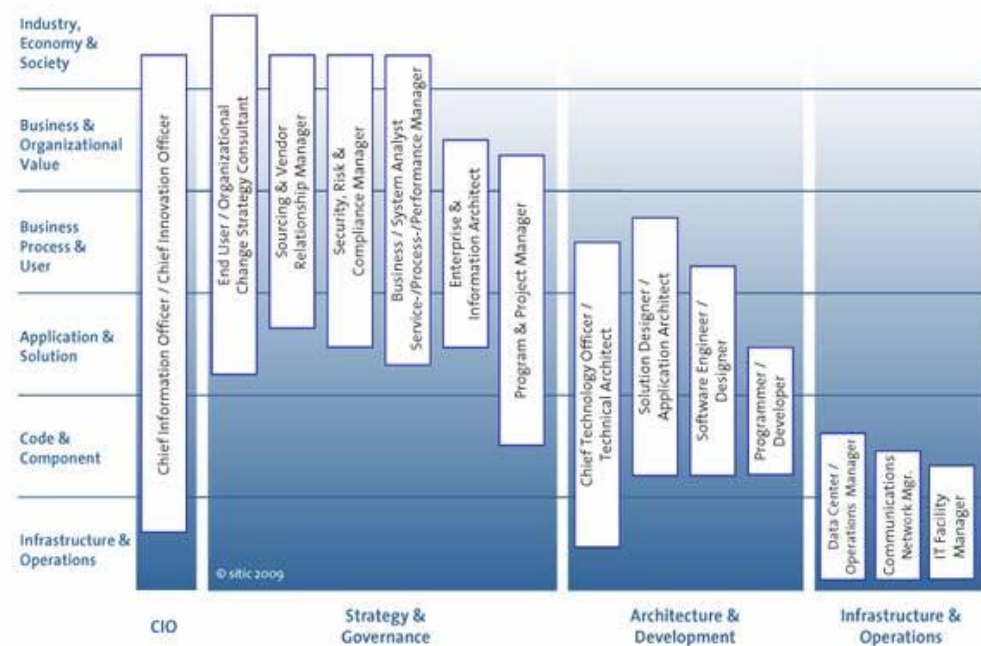
- For large companies: targets in % per year reduction of specific variable;
- For data centres: planned/realised savings/reductions in absolute terms.

User groups (in preparation)

Sitic (Swiss IT Intelligence Community) www.sitic.ch

- The Swiss IT Intelligence Community sitic is a vendor-independent peer-to-peer network. It fosters the sharing of ideas and best practices among IT departments of Swiss-based companies.
- Sitic is composed by a number of communities covering different aspects of IT in the companies.
- The Infrastructure & Operations Community is a new sitic community with focus on operations aspects of IT. It addresses Data Center Managers, Environmental and Green IT officers as logistics managers.
- The Swiss DCEE Group will participate by sharing their experience and tools.

“Infrastructure & Operations” and the other communities;
<http://www.sitic.ch/community.html>



User groups (planned)

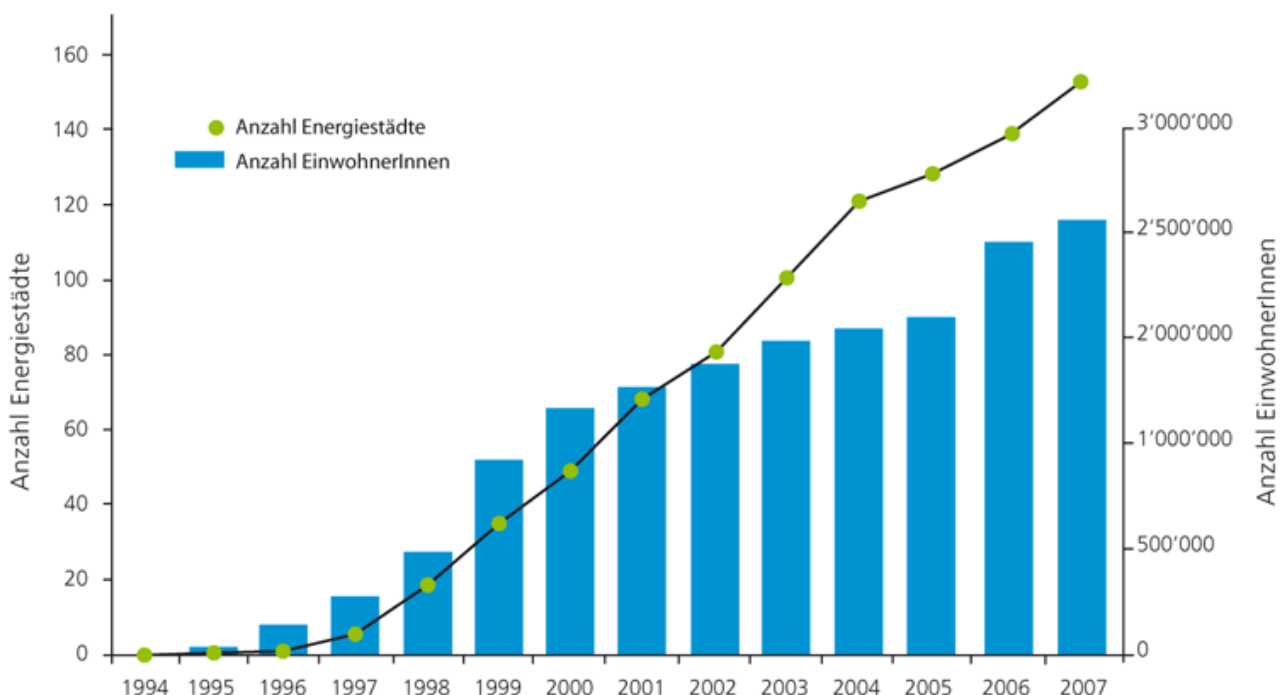
Integration of SME in “green data centres” movement

- 1st interested target group: data centres of cities/communities (Energienstadt / cité de l'énergie)
- Use experience and output of sitic user group
- Use experience of “Lernende Netzwerke” in Germany (Jochem/Gruber, 2007; Jochem, 2007; Weissenbach, 2008)

Data centres in Geneva

- Benchmarking process in order to define minimal requirements and/or target values for DCiE in new and existing data centres

Energy cities in Switzerland



Conclusions

History

- 2005-2015 : “green IT” more than a hype ?

Measurement concept

- Metering **ENERGY** (not power) is essential

User groups

- **THE** way for diffusion of energy efficient solutions

References/literature/web sites

Aebischer B. (2007). 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.

http://www.cepe.ethz.ch/publications/Aebischer_Data-Centre_ScanE_26-10-07.pdf

Aebischer B., R. Frischknecht, Ch. Genoud, A. Huser, F. Varone, 2003. Energy- and Eco-Efficiency of Data Centres. Report commissioned by the Canton of Geneva, Geneva, Switzerland

http://www.cepe.ch/research/projects/datacentres/data_centres_final_report_05012003.pdf

Aebischer B., 1996 Rationellere Energieverwendung beim Einsatz von Computern. Proceedings der Fachtagung SIWORK '96 "Workstations und ihre Anwendungen". Zürich 14.-15. Mai 1996. vdf-Verlag (ISBN: 3 7281 2342 0)

Altenburger A., 2004. Energieeffizientes Kühlen von IT-Räumen. Bundesamt für Energie, Ittigen.

<http://www.bfe.admin.ch/php/modules/enet/streamfile.php?file=000000008975.pdf&name=000000240169.pdf>

Baenninger, M., 2007. Energy consumption of large data centres in the financial sector in Zurich. Internal working paper.

Bänninger M., 1996. Mitteilung, SBG, Zürich

EnAW Energie-Modell (Switzerland) <http://www.enaw.ch/webexplorer.cfm?id=5&tlid=1>

Energiestadt / cité de l'énergie www.energiestadt.ch

Grossverbrauchermodell (Canton of Zürich)

<http://www.energie.zh.ch/internet/bd/awel/energie/de/Fachinfo/grossverbraucher-doku.html>

References/literature/web sites

- Jochem et al., 2007. Lernende Netzwerke – einer der Schlüssel zur schnellen Energiekostonenkung.
ENERGIEWIRTSCHAFTLICHE TAGESFRAGEN 57. Jg. (2007) Heft 3
- Jochem E., E. Gruber, 2007. Local learning-networks on energy efficiency in industry – Successful initiative in Germany.
Applied Energy 84 (2007) 806–816 http://www.sciencedirect.com/science?_ob=MIimg&_imagekey=B6V1T-4ND71HT-17&_cdi=5683&_user=3216521&_orig=search&_coverDate=08%2F31%2F2007&_sk=999159992&_view=c&_wchp=dGLbVlb-zSkWb&_md5=4abca5bd00bbcaed9d5e243ee573d957&_ie=/sdarticle.pdf
- Maucoronel C., P.-J. Duc, J. Willers, 2008. Standardized energy measurement concept for data centers and their infrastructures. Elaborated on behalf of the Canton of Geneva by Amstein+Walthert and Willers Engineering.
http://www.biblioite.ethz.ch/downloads/Measurement-concept_DCIE_10-2-09.pdf
- Michel B., 2007. Kühlung / Wärmerückgewinnung / Energieweaternutzung mittels Flüssigkeitskühlung. Rechenzentrum Thementag, 25. April, 2007, ETH.
- RAVEL, 1992. Strom rationell nutzen. Umfassendes Grundlagewissen und praktischen Leitfaden zur rationellen Verwendung von Elektrizität. Verlag der Fachvereine, Zürich <http://www.energie.ch/bfk/ravel/HANDBUCH.PDF>
- Singy D., D. Többen, 2005. Energy and Cost Savings with fresh Air Cooling Systems. Comtec 06/05.
<http://www.swisscom-comtec.ch/pdf/comtec062005302.pdf> and
http://www.iec.org/events/2008/bbwf/conference/infovision/cat9_swisscom.asp

References/literature/web sites

- Sitic www.sitic.ch
- Spreng D. und Aebischer B., 1990. Computer als Stromverbraucher. Schweizer Ingenieur und Architekt. Oktober
- Swiss DCEE (data centre energy efficiency) Group, 2007. Internal working paper.
- SWKI www.swki.ch
- Uptime Institute, 2006. Tier Classifications Define Site Infrastructure Performance. White Paper. A new version was published in 2008: [http://uptimeinstitute.org/wp_pdf/\(TUI3026E\)TierClassificationsDefineSiteInfrastructure.pdf](http://uptimeinstitute.org/wp_pdf/(TUI3026E)TierClassificationsDefineSiteInfrastructure.pdf) or http://uptimeinstitute.org/cgi-bin/admin2/admin.pl?admin=wp_form&id_field=9
- Weissenbach K., 2008. Modell Hohenlohe e.V.: Vom EnergieEffizienz-Tisch zum Qualitäts- und Projektmanagement System. Präsentation an Berliner Energietage 2008.
http://p4581.typo3server.info/fileadmin/Berliner_Energietage/2008/E7_Weissenbach_BET2008.pdf
- Wikipedia, 2009. http://en.wikipedia.org/wiki/Dot-com_bubble