

ICT and Energy

Dr. Bernard Aebischer, CEPE, ETH Zürich

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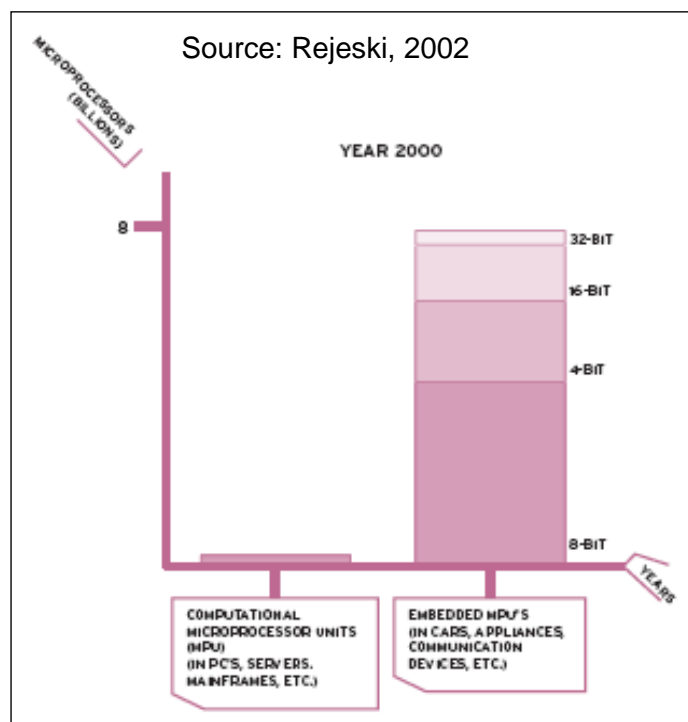
1. Energy demand of ICT today and tomorrow
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1. Energy demand of ICT today and tomorrow

- What is included in ICT?
- B.U. methodology, data, results
- EU? -> indicators information society
- Importance of infrastructure

What is included in ICT?

- There could be as many as 10,000 telemetric devices per person in the industrialized countries by 2010.
- Within a decade more things will be using the Internet than people (Michel Mayer, head of IBM Pervasive Computing)



B.U. methodology, data, results

$$\text{Energy}(t) = \sum_{ijk} n_i(t) * e_{ijk}(t) * u_{ijk}(t)$$

- with
- n: number of type i
 - e: power in functional state j
 - u: intensity of use by user k

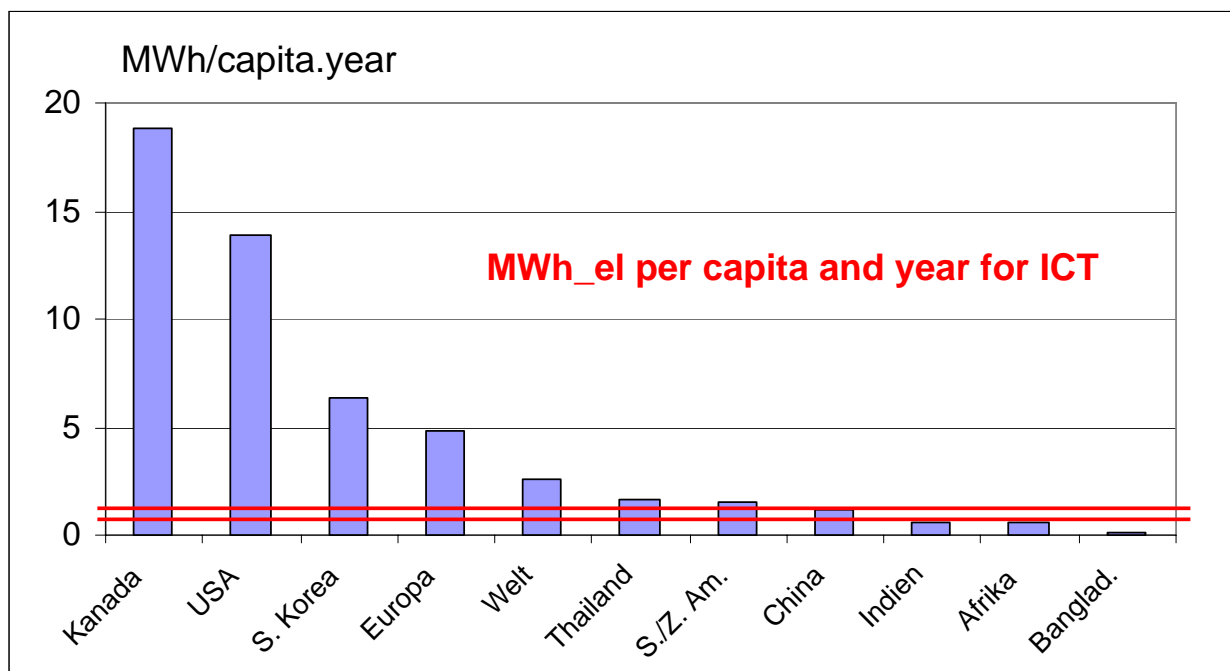
Computers, office equipment, entertainment electronics, internet, telecom, ...

- About 5% of total electricity

Plus 85% of other microprocessors used elsewhere ->

- About 10% of total electricity, or
- About 1 MWh per person and year (CH -> USA, EU?)

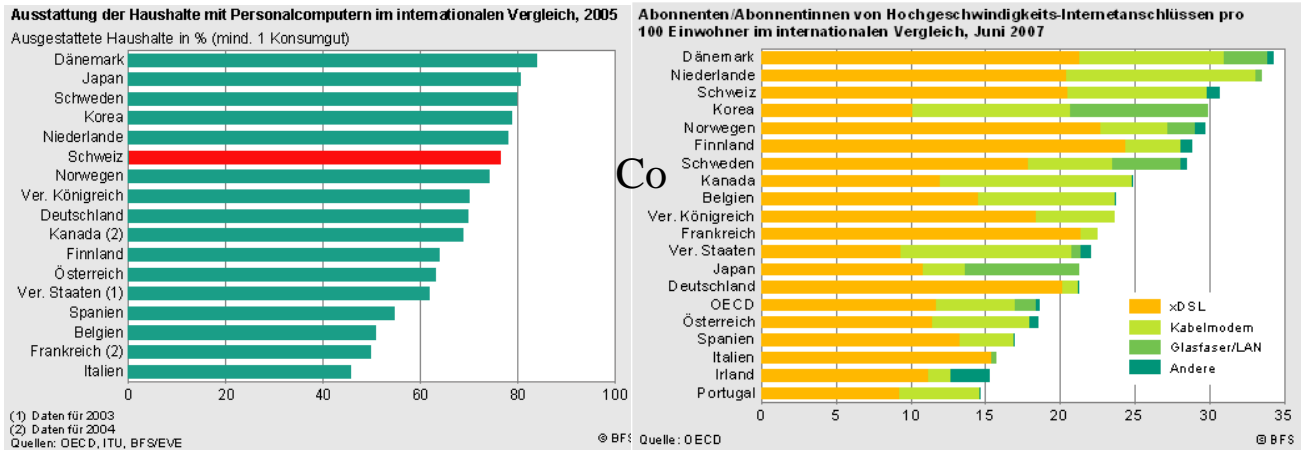
Total electricity demand per capita in different countries and electricity for ICT per capita in CH and USA



EU? -> indicators information society

Households (%) with at least 1 PC

People (%) with fast internet access



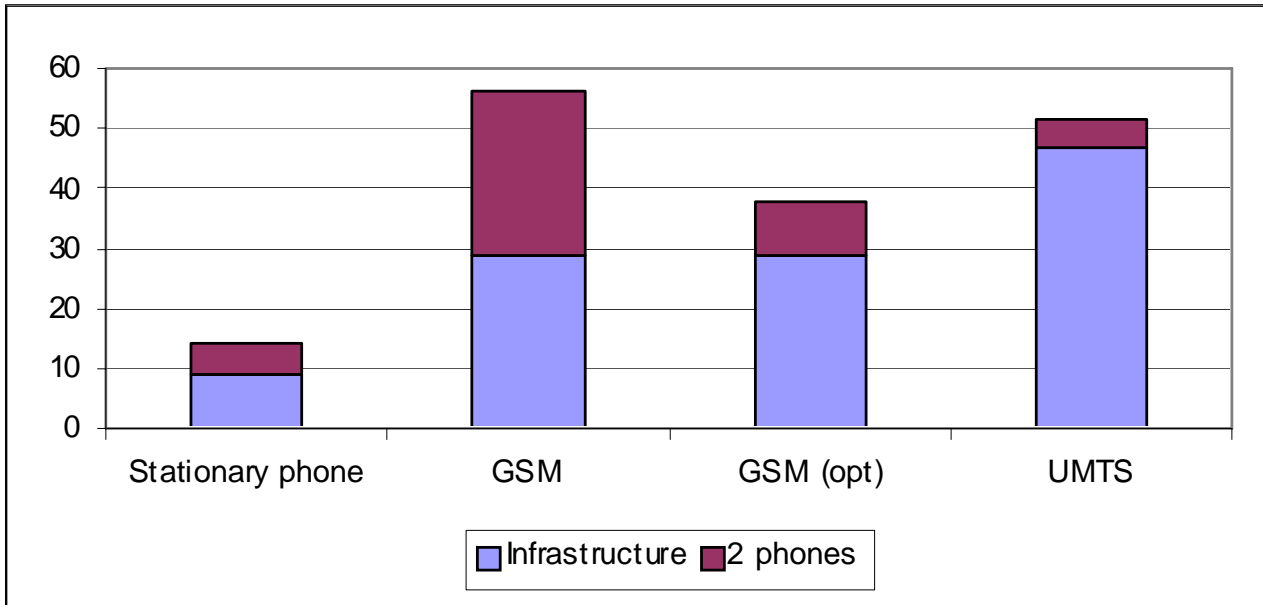
Source: www.bfs.admin.ch/bfs/portal/de/index/themen/16/04/key/approche_globale.approach.301.html

Importance of infrastructure (1)

| | | 2001 | 2010 | 2001-> | 2001 | 2010 | 2001-> | 2001-> |
|---------------------------|---------------|-------|-------|---------------------------|---------|---------|-----------------------|-------------------------|
| | | TWh/a | TWh/a | 2010 TWh/a increase | % total | % total | 2010 % increase | 2010 %/a increase |
| End-use appliances | in households | 19.1 | 24.5 | 5.3 | 50% | 44% | 28% | 2.8% |
| | in offices | 7.8 | 7.6 | -0.2 | 21% | 14% | -2% | -0.2% |
| Infra-structure | in households | 3.4 | 6.4 | 3.0 | 9% | 12% | 89% | 7.3% |
| | in offices | 5.4 | 11.1 | 5.7 | 14% | 20% | 105% | 8.3% |
| | public | 2.3 | 5.8 | 3.6 | 6% | 10% | 158% | 11.1% |
| Total | ICT | 38.0 | 55.4 | 17.4 | 100% | 100% | 46% | 4.3% |

Electricity demand 2001 et 2010 in Germany of ICT, by "end-use" in households and offices and by "infrastructure" in households, offices and public infrastructure. Source: Cremer, Aebischer et al., 2003

Importance of infrastructure (2)



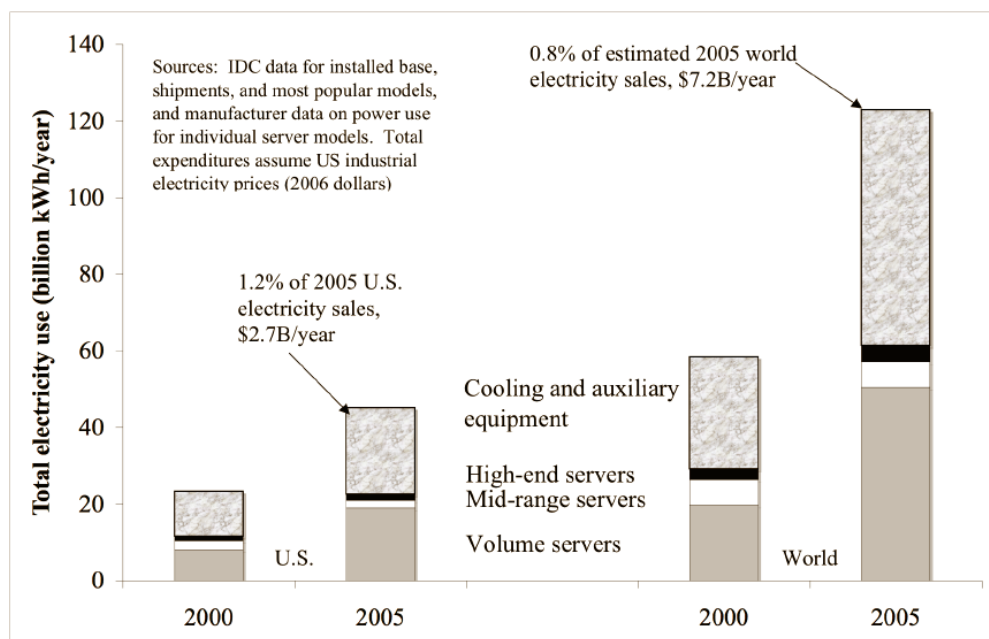
Mobile telecommunication, in kWh/Gbit (Faist et al., 2003)

Importance of infrastructure (3)

Figure ES-1: Total electricity use for servers in the U.S. and the world in 2000 and 2005, including the associated cooling and auxiliary equipment

regionally
1%-10%
or more (e.g.
a 20 MW
data center =
80'000
people)

Source:
Koomey,
2007



Importance of infrastructure (3)

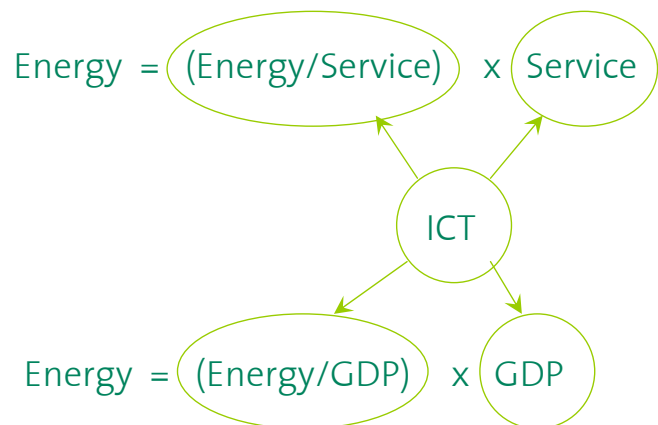
| | TWh/a | TWh/a | | |
|----------------|-------|-------|--------|-------------|
| | 2000 | 2005 | Growth | Growth rate |
| US | 23.3 | 45.1 | 94% | 14% |
| Western Europe | 15.1 | 33.3 | 121% | 17% |
| Japan | 6.7 | 12.9 | 93% | 14% |
| Asian Pacific | 5.8 | 16.0 | 176% | 23% |
| Rest of World | 7.6 | 15.5 | 104% | 15% |

Electricity demand of servers (including infrastructure to run the servers) in five world regions. Source: Koomey, 2007/2

More → Aebischer/Roturier, 2007; Souchon et al., 2007

2. Impact of ICT on energy demand

- What has to be considered?
- Micro, case studies
 - some examples...
- Macro
 - E-business w@tch:
desk research
(Madlener, 2008)
 - A recent article about
impact on US economy



What has to be considered?

1. Direct energy demand -> increasing electricity demand (1st part)
2. Indirect energy demand
 - Energy over life cycle (embodied/grey energy)
 - Efficiency improvements of technical and economic processes, of vehicles/mobility, buildings
 - Structural changes / substitutions, dematerialisation
 - Faster economic growth (faster increase of productivity)

Micro analysis, case studies

- Processes: control, regulation, adjustment (Spreng, Berkhout, ...)
- Building automation, intelligent homes (Aebischer/Huser, ...)
- Transport: cars, traffic management
- E-economy: e-commerce, e-work, e-government, ... (Heiskanen, ...)

Macro analyses (1)

- Collard et al., 2005: Electricity consumption and ICT in the French service sector.
Key findings: electricity intensity of production has increased (decreased) with diffusion of computers/software (comm. devices)
- Takase/Murota, 2004: Impact of IT investments on energy demand in Japan and US.
Key findings: by promoting IT, Japan could conserve energy, while the US would likely increase its energy use!
- Laitner, 2003: Is the information economy an energy hog, productivity tool or both?
Key findings: interrelated trend will likely generate small decreases in energy intensity

Source: E-business w@tch: desk research (Madlener, 2008)

Macro analyses (2)

A recent article about impact of ICT on US economy

Laitner and Ehrhardt-Martinez, 2008: Information and communication technologies: the power of productivity. How ICT sectors are transforming the economy while driving gains in energy productivity.

Key findings: „For every extra kilowatt-hour of electricity that has been demanded by ICT, the U.S. Economy increased its overall energy savings by a factor of about 10 !?!?!?!“

3. Concluding remarks (1)

- Investments or capital stock in ICT = major indicator in “macro analysis”, but not specified what ICT is used for.
- ICT usually used to increase (labor) productivity only and not or a more rational use of energy
→ Spreng’s triangle: substitution of time and energy (Spreng, 1993)

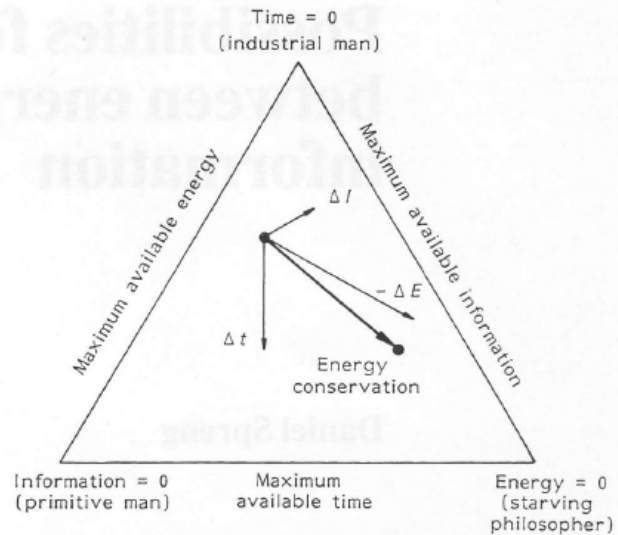


Figure 3. The time–energy–information triangle.^a

3. Concluding remarks (2)

- ICT for development
 - WSIS → action plan, but hardly considered infrastructure need and know-how and ...
 - 100 USD laptop ...
 - Common Service Centres (CSC) scheme of the Indian Government

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