

Latest Measured Data on Data Center Power Use in the U.S.

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For more details on the analysis discussed here, go to

<http://N4E.LBL.gov>

Download: <http://enduse.lbl.gov/shareddata/datacenterstalk020312.ppt>

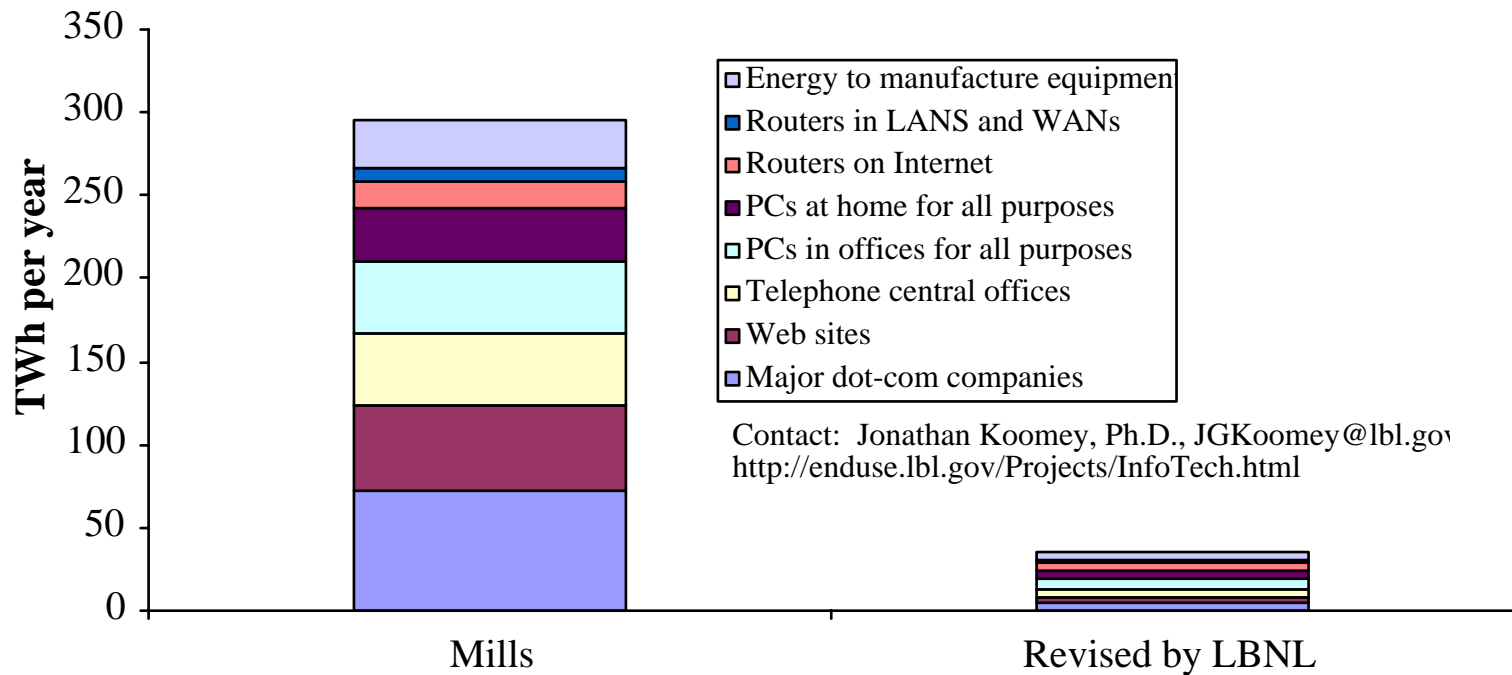
To be presented at the 2002 NEMS conference

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Background

- • *The Internet Begins with Coal*, was published in *Forbes* in May 1999. Results were widely cited and have become conventional wisdom
 - Internet = 8% of all electricity use
 - All office equipment = 13% of all electricity use
 - Total projected to grow to 50% of all electricity use in 10-20 years
- These numbers are incorrect, but their prominence has prompted much research.

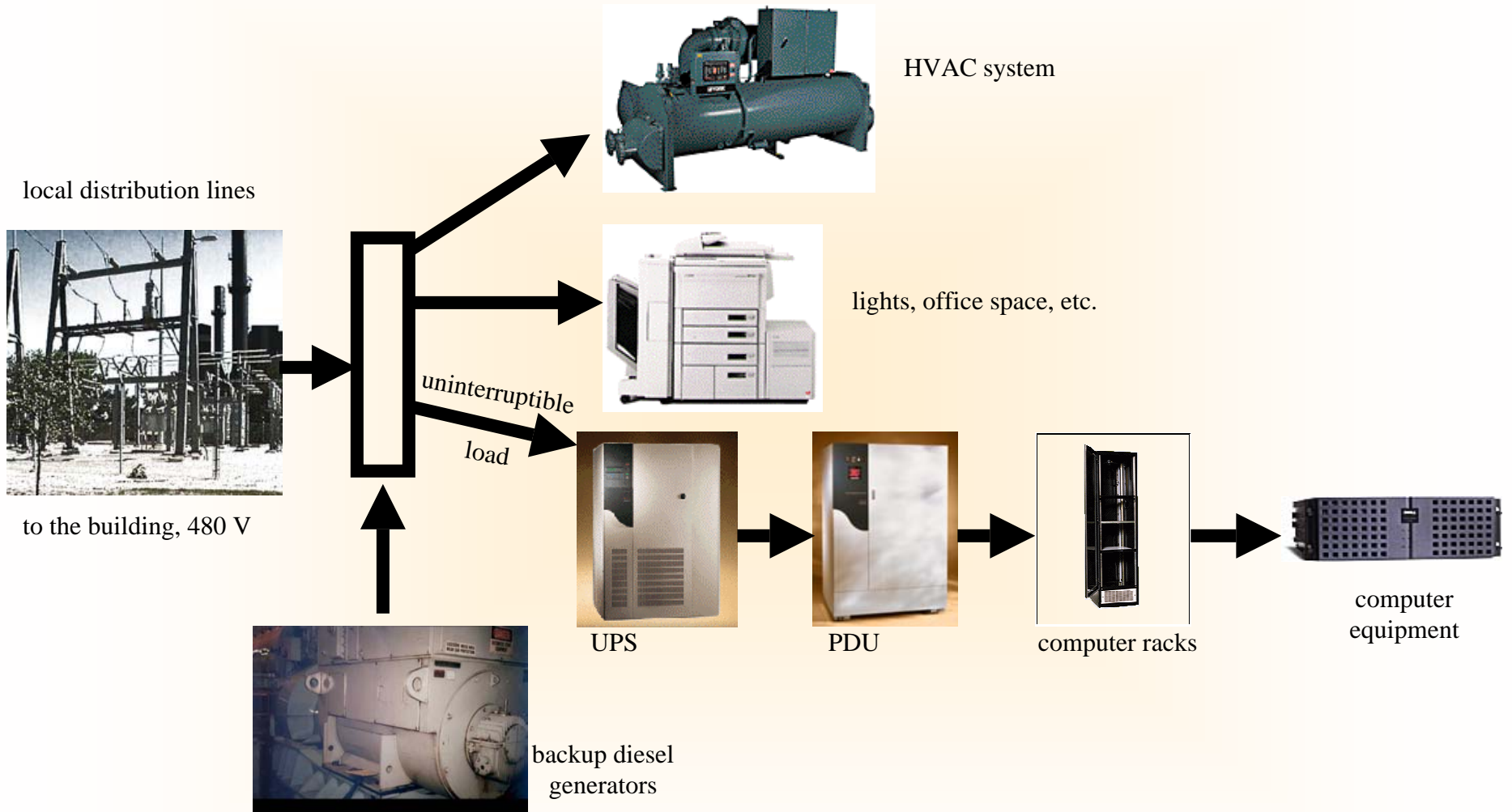
Mills' electricity "used by the internet in 1999", corrected by LBNL



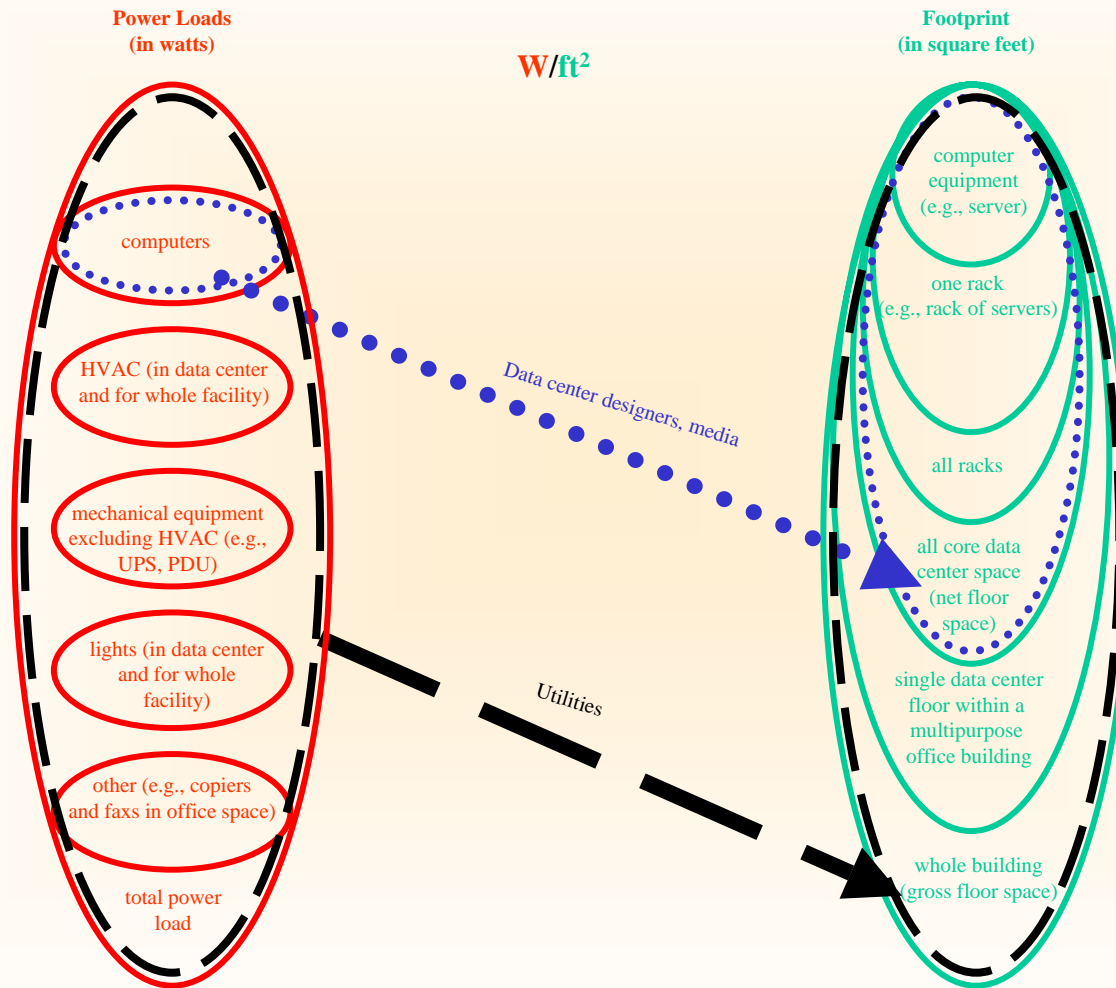
Data centers/server hotels

- • Some utilities receiving requests for tens to hundreds of MW of power from proposed data centers
- Estimates for power use almost certainly too large
 - One facility maximum = 90 W/sf, actual <40W/sf.
 - Another facility claimed 65 W/sf, but floor area defined incorrectly to exclude aisles and other common areas, leading to an overestimate of power use (this definition is critical)
 - Still another facility took direct server load and multiplied by three (!) to account for cooling, lighting, and other uses

Electricity Flows in Data Centers



Defining metrics for data centers



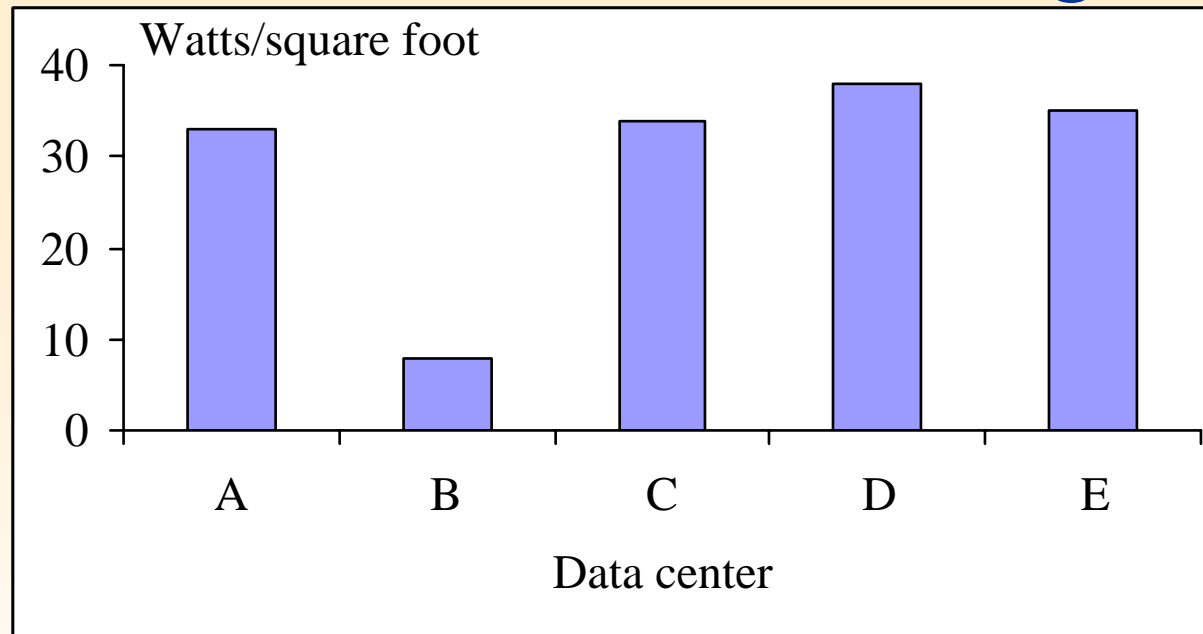
Results from one data center based on measured data

Term	Definition	Power use Watts/sf
Computer Power Density	Power drawn by the computer equipment (in watts) divided by the computer room floor area (in square feet)	16
Total Computer Room Power Density	Power drawn by the computer equipment and all of the supporting equipment such as PDUs, UPSs, HVAC, and lights (in watts) divided by the computer room floor area (in square feet)	33
Building Power Density	Total power drawn by the building (in watts) divided by the total floor area of the building (in square feet)	11

(1) Source: Mitchell-Jackson, Jennifer. 2001. *Energy Needs in an Internet Economy: A Closer Look at Data Centers*. M.S. Thesis, Energy and Resources Group, University of California, Berkeley. <http://enduse.lbl.gov/projects/infotech.html>

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Total computer room power densities based on billing data



(1) Source: Mitchell-Jackson, Jennifer. 2001. *Energy Needs in an Internet Economy: A Closer Look at Data Centers*. M.S. Thesis, Energy and Resources Group, University of California, Berkeley. <http://enduse.lbl.gov/projects/infotech.html>

(2) Data are for server hosting facilities and are not necessarily representative of corporate data centers. Power use includes all HVAC and auxiliary equipment.

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Electricity used by hosting-type data centers in the U.S

	<i>Units</i>	<i>2000</i>	<i>Low 2003</i>	<i>Best estimate 2003</i>	<i>High 2003</i>
Floor area at end of year	Msf	9.5	20	25	30
Data center total power density	W/sf	50	35	60	85
Data center total power	GW	0.5	0.7	1.5	2.6
Data center electricity use	TWh	4	6	13	22
<i>Data centers as % of total use</i>		<i>0.12%</i>	<i>0.17%</i>	<i>0.36%</i>	<i>0.62%</i>
Total U.S. electricity use	TWh	3364	3608	3608	3608

(1) Source: Mitchell-Jackson, Jennifer. 2001. *Energy Needs in an Internet Economy: A Closer Look at Data Centers*. M.S. Thesis, Energy and Resources Group, University of California, Berkeley. <http://enduse.lbl.gov/projects/infotech.html>

(2) Power density estimates ignore the possibility that server loads are shifted from existing installations and are not new loads.

(3) Electricity use calculated assuming 8760 hours per year operation, flat load curve.

(4) Total U.S. electricity use taken from EIA's Annual Energy Outlook 2001.

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Publications

- Article summarizing latest estimates of power used by office equipment in Energy--The International Journal, vol. 27 (3) pp. 255-269.
- Article summarizing latest estimates of power used by a specific South Bay data center under review by Energy--The International Journal.
- Article summarizing latest estimates of aggregate power used by data centers to appear in a special issue of Resources, Conservation, and Recycling.

Future work

- ❑ Working with Uptime institute to compile data on power used by corporate data centers.
- ❑ Seeking more accurate data on floor area of hosting and corporate data centers.
- ❑ Collecting data on measured consumption of all different types of office equipment for EPA's Energy Star program.

Conclusions

- ❑ Misinformation seems to spread more quickly than truth.
- ❑ Bad data = wrong decisions
- ❑ Electricity used by computers and network equipment= 3% of U.S. electricity use, not 13%.
- ❑ Electricity used by data centers is relatively small in the aggregate; in certain cities such centers can be important contributors to load.

Conclusions (continued)

- More work needed to estimate floor area for hosting facilities and corporate data centers, given the volatility in the market.
- Credible data are urgently needed. Join our network for energy, environment, efficiency, and the information economy (N4E) at

<http://n4e.lbl.gov>

