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Melinda S. Eden
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Northwest Power and Conservation Council

April 30th, 2008

MEMORANDUM

TO: Power Committee

FROM: Massoud Jourabchi

SUBJECT: Energy implication of data centers in the Northwest

What is a data center? "Data Center" is a generic term used to describe a number of different types of facilities that house digital electronic equipment for Internet site hosting, electronic storage & transfer, credit card & financial transaction processing, telecommunications, and other activities that support the growing electronic information-based economy.[1]

In general, data centers can be categorized into these two main categories:

1. Custom Data Centers - e.g. the Google, Yahoo, and Microsoft sites in the Grant County PUD and Northern Wasco County PUD. These data centers are typically very large consisting of thousands of servers and representing tens of megawatts of power. They are usually sited in new facilities and are served on industrial retail rates.
2. Hidden Data Centers- e.g. those used in the Council's main office. These data centers are small rooms containing a range from a few servers up to hundreds of servers and are called hidden data centers because they are an integrated part of existing commercial businesses. They are typically sited in an urban setting in existing office buildings and are served on a commercial retail electric rate.

Tracking the electricity use of data centers, especially custom data centers, is important because of their fast growth rate and their large size. Our current estimate is that we have about 300 MWa of connected load for use in custom data centers in the region and another 300 MWa of load that can be attributed to hidden data centers. If national projected trends for non-custom servers holds true, the load from these data centers can increase up to 50% by 2011.

There is a potential for conservation opportunities in data centers, however assessment of this potential is not possible at this time due to lack of good baseline conditions for the data centers. As part of development of the Sixth Plan we will be developing improved information on data centers.

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[1] http://www.gulfcoastchp.org/Markets/Commercial/DataCenters

Energy Implications of Data Centers

May 2008 Council Meeting

Walla Walla, Washington

Topics covered

➢ What is a data center

➢ Characteristics of data centers

➢ Energy consumption of data centers

➢ Conservation opportunities

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What is a Data Center?

➢ Data center or server farm is a generic label for facilities that house:
- Hardware
  - Servers (computers)
  - Storage Devices
  - Power backup Devices (PDC, and UPS)
  - Communication devices (Routers, Switches, etc)

- And of course the Software to control

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Types of Data Centers

➢ Hidden Data centers
- Server closets, rooms
- Enterprise data centers
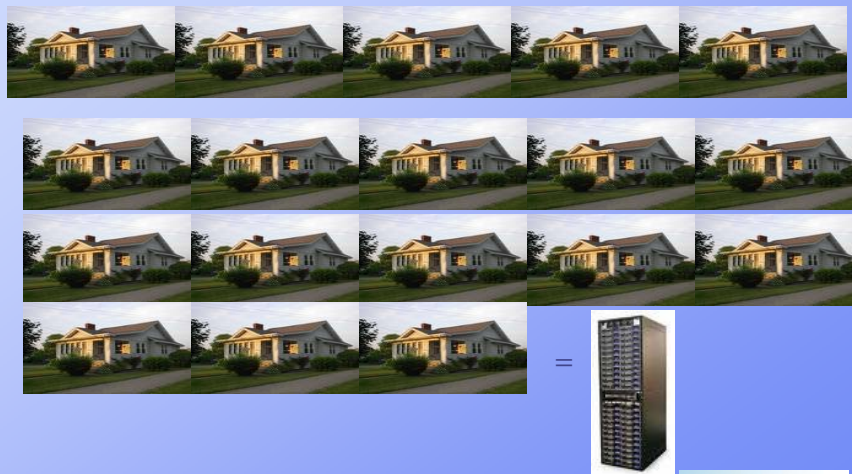- Co-Located Server Hosting facilities
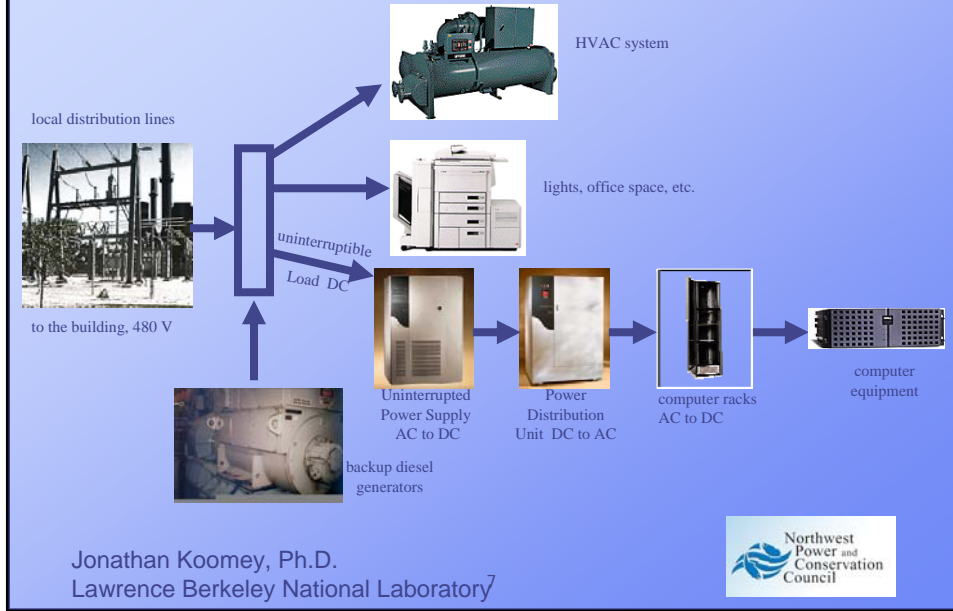➢ Custom Data centers
- Yahoo
- Google

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Typically data centers are not designed for humans

Very large custom data centers built in NW have only 30-40 employees

But They Have a Large Energy Footprint

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Electricity Flows in Data Centers

HVAC system

local distribution lines

lights, office space, etc.

uninterruptible

Load DC

to the building, 480 V

Uninterrupted
Power Supply
AC to DC

Power
Distribution
Unit DC to AC

computer racks
AC to DC

computer
equipment

backup diesel
generators

Jonathan Koomey, Ph.D.
Lawrence Berkeley National Laboratory

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Breakdown of Electricity Consumption in a Typical Data Center

Network 10%

Server
75%

Storage
15%

and about 50%
of servers
energy
requirement is
to remove
heat
generated by
the servers

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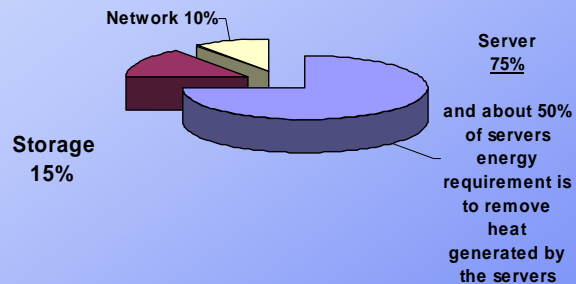
Estimates of Data Center Load in the Northwest

➢ Hidden Data Centers ~300 MW
  ▪ About 1.5% of regional Load
    ▪ Concentrated in information tech firms
    ▪ Law and accounting firms
    ▪ Northwest share slightly higher than national average.

In addition Northwest has attracted

➢ Custom Data Centers ~ 300 MW
  ▪ Connected load
    ▪ Will be phased in over the next few years.

➢ Data centers have flat hourly load profiles.

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Future Load Growth at Data Centers

➢ In 2006, Data center loads were projected to double by 2011, however limiting factors and efficiency improvements is expected to keep slowdown pace of growth:

  ▪ Local power supply constraints
  ▪ water/water treatment constraints
  ▪ Low power prices availability
  ▪ Space constraints
  ▪ Demographics of high-tech information firms
  ▪ Improved efficiency of existing and new installations

➢ Data center loads could increase by 50% by 2011.

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Large Efficiency Opportunities

➢ **In server use optimization.**

  A recent survey found:

  - 32% of servers were practically dead (utilization rates below 3%)
  - 63% of servers have peak and average utilization below 10%

➢ **In Better Cooling and power load management**

➢ **In Better storage management**

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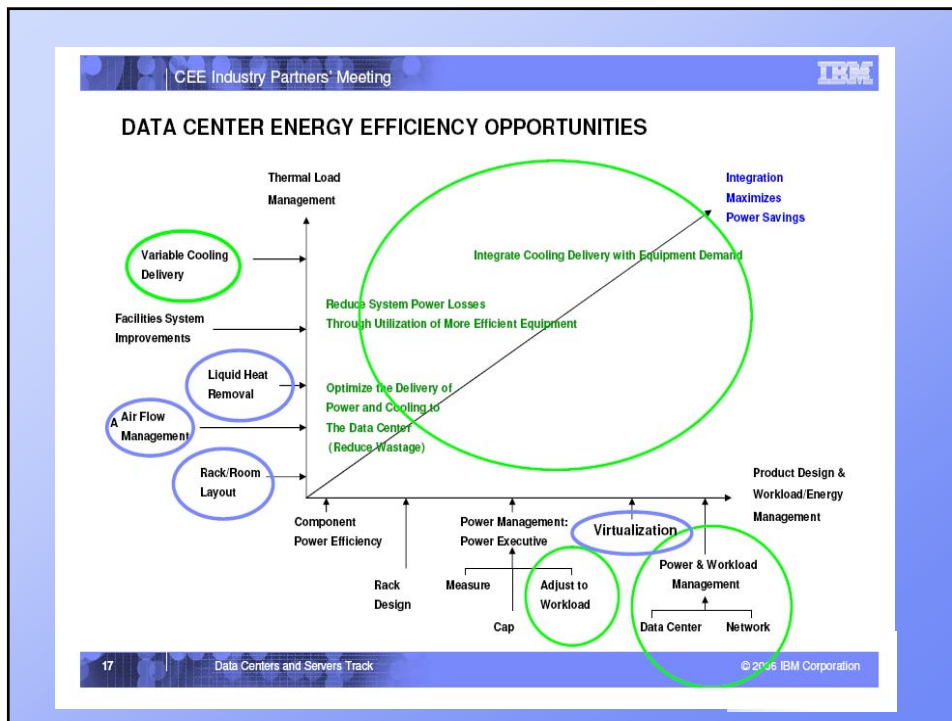
Energy Efficiency Tactics

➢ Optimize power delivery system
➢ Use higher temperature settings in the cold and hot aisles.
➢ Reducing cooling load
   ▪ Right sizing the equipment
   ▪ Integrate cooling delivery with demand
   ▪ Use Water cooling
   ▪ Separating hot and cold aisles
   ▪ Using outside air more often (economizers)
➢ Use Virtualization to reduce number of servers

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Possible Range of Efficiency Opportunities

➢ Low Hanging Fruit: Data Center Thermal Assessments
   ▪ – 5-15% Savings Available
➢ Server Consolidation Projects
   ▪ – Large Opportunity: 20-80%
   ▪ Depending on Hardware and Workloads

Source: Data Centers and Servers Track © 2006 IBM Corporation

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Past , Present, and Future

1970s

Current

Cloud
Computing

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