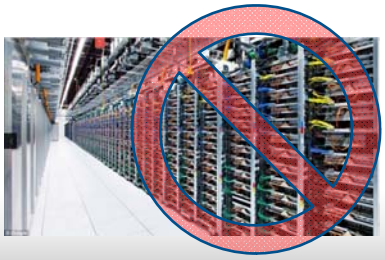
Embedded Data Centers
(Update)

CRAC January 28, 2014

Northwest Power and Conservation Council

SEVENTH NORTHWEST POWER PLAN

Data Centers within Commercial Buildings
Exclude Dedicated DC Buildings



Northwest Power and Conservation Council

SEVENTH NORTHWEST POWER PLAN

Embedded Data Centers

Preliminary*

Parameter	Sixth Plan	Seventh Plan (draft)
Number of Embedded Data Centers	Unknown	43,000*
Estimated PNW Load All Data Centers (aMW)	600 (2010)	960 (2014)*
Estimated PNW Load Embedded Data Centers (aMW)	~300 (2010)	~460 (2014)*
Technical Potential (aMW over 20 years)	130 (Virtualization)	~200 to 250 *
Levelized Cost ($/MWh)	(-$60)	Very low

* Will update with final CBSA data

Embedded Data Centers

Preliminary*

Parameter	Sixth Plan	Seventh Plan (draft)
Number of Embedded Data Centers	Unknown	43,000*
Estimated PNW Load All Data Centers (aMW)	600 (2010)	~~960~~ (2014*) 780 Revised
Estimated PNW Load Embedded Data Centers (aMW)	~300 (2010)	~~~460~~ (2014)* ~280 Revised
Technical Potential (aMW over 20 years)	130 (Virtualization)	TBD
Levelized Cost ($/MWh)	(-$60)	Very low

* Revised CBSA data reduced load estimate

IT Device Efficiency Drivers Revisions

Parameter	Compound Annual Growth Rate
Server computations	41% *
Server computations per watt	56% **
HDD areal density	12%
HDD storage TB per watt	10%
Network gear GB capacity	10%
Network GB per watt	11%

Propose to revise downward to 20% after talking to Koomey & others

* Moore's Law
** Koomey's Law

Impact of Changes

- Initial loads lower
- But loads growing slowly
  - Instead of shrinking
- Conservation potential similar long term
  - 200 to 250 aMW and mostly low cost