IT Energy Efficiency Opportunities
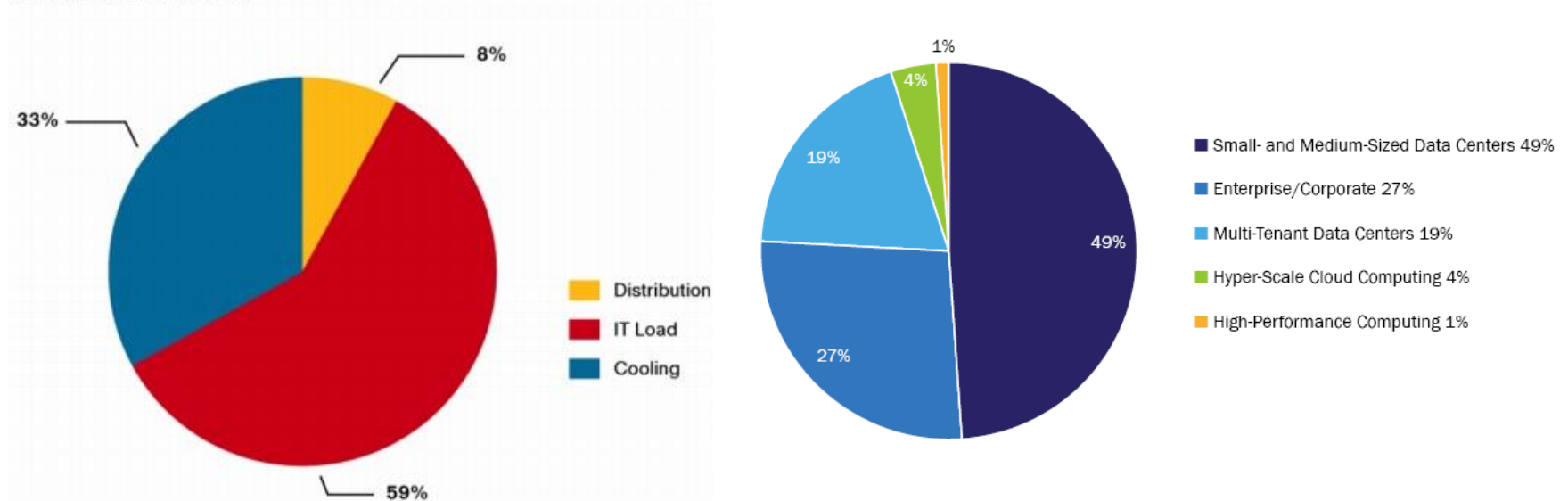
NREL Partner Meeting – November 2, 2016

John Clinger, ICF

Why Does IT Energy Matter?

Where Does the Power Go?

Pie chart 1 (Where Does the Power Go?):
- Distribution: 8%
- IT Load: 59%
- Cooling: 33%

Pie chart 2:
- Small- and Medium-Sized Data Centers 49%
- Enterprise/Corporate 27%
- Multi-Tenant Data Centers 19%
- Hyper-Scale Cloud Computing 4%
- High-Performance Computing 1%

- In addition, reports from the EU and Australian government show ~90% of IT usage comes from servers and storage, while only 10% comes from networking.

ENERGY STAR® IT Product Labels

- Applies to:
  - Computer Servers
  - Data Center Storage
  - Large Networking Equipment (LNE)
    - Switches & Routers
  - Uninterruptable Power Supplies
- Does not apply to:
  - HPC purpose built hardware
  - Security appliances (firewalls etc.)
  - Mainframes
- Requirement for federal procurement, and also included in RFQs for many private organizations
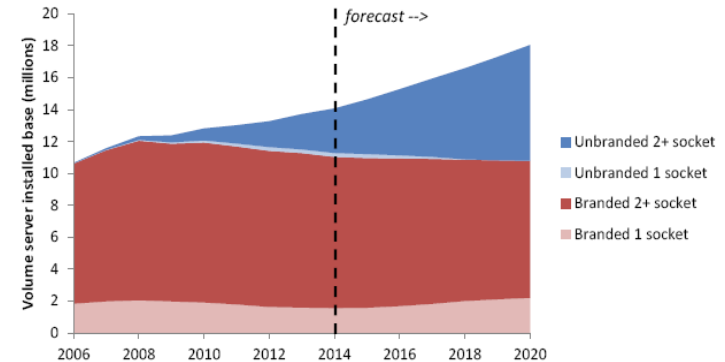

Figure 6. Volume Server Installed Base 2000-2020

ENERGY STAR® IT Product Labels

- Common requirements across Servers, Storage, LNE include:
  - PSU efficiency and power factor requirements
  - Active state work/watt requirements covering different workloads types
    - Servers → 12 workloads
    - Storage → 3 workloads
    - LNE → 3 workloads
  - Product level metering and reporting requirements
    - Inlet air temp
    - Input power
    - Average processor utilization
  - Power management requirements
- Servers are also subject to Idle state requirements, addressing energy usage at very low utilization, or the worst case, zombie servers

Technology Considerations for Servers

- **Microservers**
  - Typically mobile chipsets used in blade server form factor
  - Much more efficient for light workloads like web hosting
- **Virtualization**
  - Running multiple virtual machines (unique unmodified OSes and/or applications) simultaneously on one physical server
- **Onboard GPGPUs, FPGAs for parallel workloads**

Technology Considerations for Storage

- **Auto-tiering / hybrid systems**
  - Intelligent software based placement of data on the most appropriate drives within mixed drive systems.
- **Capacity Optimizing Methods (COMs)**
  - COMs are **not** one size fits all depending on data type and workload
  - Types of COMs:
    - Data Deduplication
    - Thin Provisioning
    - Delta Snapshots
    - Compression

Open Compute / Customized Approaches

- Customized approaches are popular in the hyperscale sector
  - ODM hardware is retrofitted to maximize performance and/or minimize energy consumption for a very specific workload type, within a specific infrastructure environment
- Open Compute Project provides open source guidelines for custom hardware design in the data center.
  - Facebook (challenge partner) started the project, and are a great resource on the topic
  - Project focuses on minimizing cost and maximizing energy efficiency, but not necessarily maximizing performance.

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High Performance Computing

- **Heterogeneous accelerator-based systems**
  - 80% of the top 50 systems in the latest Green 500 list (June 2016) use accelerators where workloads that can be parallelized are directed to GPU-like hardware rather than traditional CPU hardware within the same system.

- **Most efficient systems are breaking 6000 MFLOPS/watt**
  - Important because some users are reaching the limitation of their existing utility feeds and need to get more out of the power available to them.
  - Largest systems eclipsing 15MW of IT load.

- **For more info look into the EE HPC WG (ask Dale)**

Utility IT Equipment Rebate Opportunities

- **Three target areas for IT based rebates:**
  1. Install energy efficient IT equipment
  2. Consolidate and/or virtualize compute, storage, and networking resources
  3. Implement improved power management practices

List of Electrical Utilities & Organizations Offering Energy-Efficiency Rebates or Incentives*			
Alliant Energy	Iowa	Massachusetts Electric	Massachusetts
Ameren	Missouri	Narragansett Electric	Rhode Island
Austin Energy	Texas	New Hampshire Electric Cooperative	New Hapmshire
Blackstone Valley Electric	Rhode Island	New York State Energy R&D Authority (NYSERDA)	New York
Burlington Electric	Vermont	Newport Electric	Rhode Island
Cape Light Compact	Massachusetts	NSTAR	Massachusetts
CenterPoint Energy	Texas	Oncor	Texas
ComEd	Illinois	Pacific Gas & ELectric (PG&E)	California
Concord Electric Company	New Hampshire	Progress Energy	Florida
Connecticut Light & Power	Connecticut	Public Service of New Hampshire	New Hampshire
CPS Energy	Texas	Puget SOund Energy (PSE)	Washington
Duke Energy	Ohio & Kentucky	Sacramento Municipal Utility District (SMUD)	California
Efficiency Vermont	Vermont	Salt River Project (SRP)	Arizona
Energy Trust of Oregon	Oregon	San Diego Gas & Electric (SDG&E)	California
Exeter & Hampton Electric Company	New Hampshire	Seattle City Lightq	Washington
Fitchburg Gas & Electric	Massachusetts	Southern California Edison (SCE)	California
Florida Power & Light (FP&L)	Florida	Tampa Electric	Florida
Granite State Electric	New Hampshire	United Illuminating Company	Connecticut
Kansas City Power & Light	Missourie & Kansas	Western Massachusetts Electric Company	Massachusetts
Long Island Power Authority (LIPA)	New York	Wisconsin Focus on Energy	Wisconsin
Los Angeles Department of Water & Power (LADWP)	California	Xcel Energy	Minnesota

Questions?

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