

# Data Center Power and Cooling

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# What uses power in a data center?

- AC
- UPS
- Lights & other building infrastructure
- IT Gear
  - Servers
  - Storage
  - Network & other IT infrastructure

# What needs cooling in a data center?

- Anything that uses power
- Plus a few extras...
  - Humans
  - Environment

# Electricity comes from...

- The grid
- UPS
  - Wet cel
  - Dry cel
- Generator
  - Natural gas (< 150kw)
  - Diesel (>100kw)

# Cooling comes from...

- Traditional AC
- Heat Exchangers
- Environment
  - Humidity is a factor too

# Useful Terms

- Volts/Amps/Watts, Celsius/Fahrenheit, Dollars
- Rack Units: physical size
  
- kWh/kVA: electricity (cf. power factor)
- 110/220/440, 1 or 3-phase: types of electricity
  
- BTU: heat
- Tons: cooling
- CFM: airflow
  
- PUE/DCiE: data center efficiency
- TCO/CAPEX/OPEX: money

# The Importance of Good Design

- Traditional DC, not much planning
- Hot/Cold Aisle separation
- Aisle containment
- Rack containment
- DC containment

# Case Study: WCC Primary Server Room

- **The Problem: Hotspots, some servers running with constant heat alarm, AC's always running.**
  1. Gather temp/airflow/elec data
  2. Test out different designs
  3. Determine savings of each
  4. Implement new design

# A Few Good Data Centers

- Yahoo in Buffalo, NY
- Google in Mons, Belgium
- WMU in Kalamazoo, MI
- UMHS in Ann Arbor, MI
- Others...