Datacenter Cooling Planning

Estimating cooling needs

BTU is used to measure heat. AC units are measured in tons of AC. 1 ton of AC is 12,000 BTU.

For calculating power, companies like Dell and HP offer spreadsheets to determine exact power consumption of a single server.   If you have a homogeneous setup and want to plan down to the watt, use these.   I find them to be cumbersome and time consuming.

For a general ballpark answer, there is a simpler way.   Maintain a power budget per rack. 6500 watts is a basic power budget, today. This approximates to three 20 amp 110v circuits.

With 6500 watts of power, the cooling needed to offset computers is easy.   Each watt contributes 3.41 BTU to the datacenter. If you have a server room of 10 racks, and each rack is limited to 6500 watts, cooling requirements are:

$6500 * 3.41 = 22,165$ BTUs/rack $= 221,650$ BTUs.

In this case, you want 19 tons of AC to completely offset the heat generated by computers.

AC units

Typically, bigger is better.   Even a small datacenter with a few machines may use a ton of AC. Plan to grow over the lifetime of the datacenter.   Each generation of computer is smaller and faster causing more heat so what works today may not work after upgrading to the next level processor.   Ensure maintenance agreements exist on the AC with a local cooling specialist. If the AC fails, you'll need to repair it quickly. Otherwise, critical resources will need to shutdown in order to limit temperature in the room.

Saving AC

AC gets expensive fast!   Rack layout is a key criterion to reducing AC expenditures. Most server rooms today use a hot isle/cold isle layout. This means every other row faces the opposite direction. If you walk down an isle, you see only fronts…or only computer backs. The goals:

- Isolate the cool air so it doesn't bleed into the hot area
- Ensure all machines are pulling cool air into the machine and hot air out and into the hot isle
- Create efficient airflow by covering holes in racks to create a thermal wall
- Locate AC air ducts in front of machines and return air ducts on the backs of machines
- If in a raised floor environment, send cool air in from the bottom since heat rises.

Below is a diagram of a datacenter which utilizes cool isles and hot isles.   Air (blue) rises from below, goes into the PCs in the rack, and then exits into the hot isle (red).
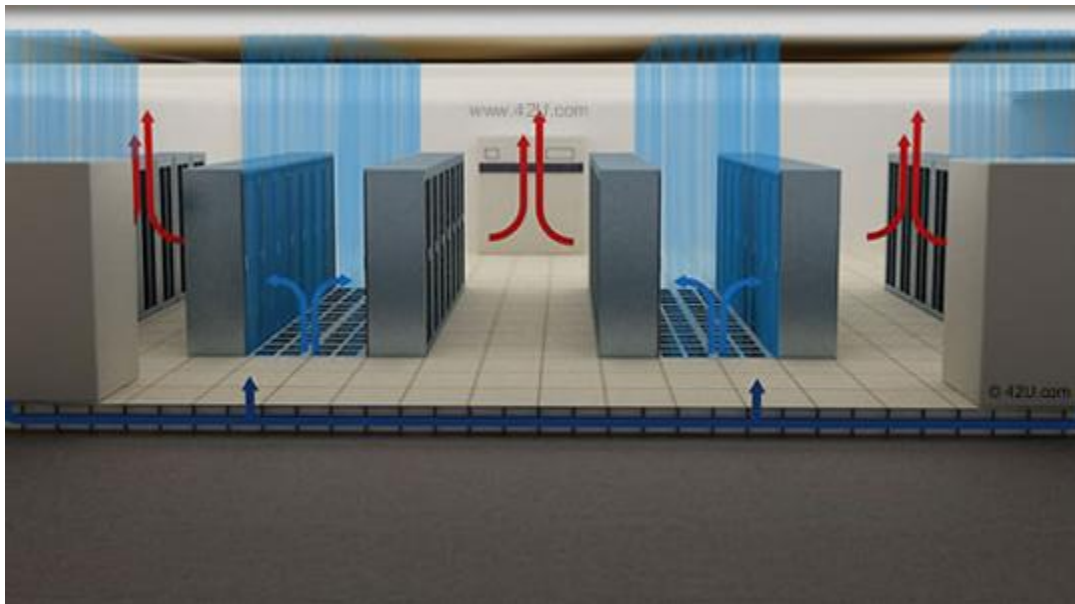
Be aware of environmental conditions that are not server related. If the server room has a window, sunlight will cause additional BTU. This is especially true for the south side exposures in the US. If people are always in the room, take into account their heat. Lights also play a role.