Cool Cooling Technologies
and Where They are Coming From

Energy 2003
Orlando

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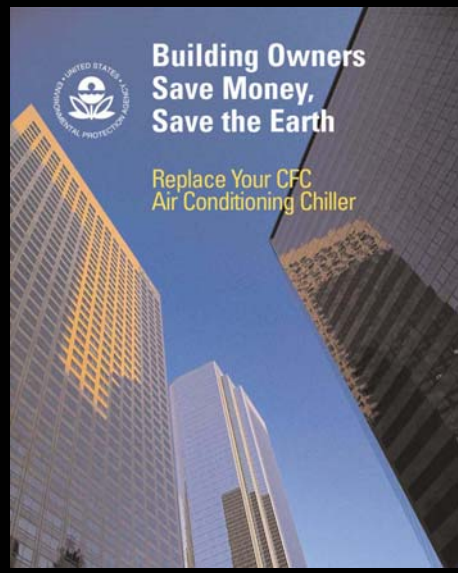
New Cooling Technologies

- First: Why
  - Regulations driving energy efficiency up and emissions down
  - Loads getting smaller (office buildings) as equipment, buildings get greener
  - Loads getting higher (data centers) as computers decrease in size but increasing in power/heat intensity
  - Chillers getting smaller, simpler, more flexible
  - Controls and piping/pumping methodologies are getting more complex

Cooling Industry Direction

- Chiller selection: Focus on the application, not the refrigerant
  - See EPA brochure (handout)
  - Note the sponsors on the back of it
    - Carrier, McQuay, Trane, York, etc.
    - *HPAC Engineering*
  - The end of the (overt) "refrigerant wars?"
    - Companies will compete
  - Europeans putting pressure on R-134a
    - Greenhouse gas (HFC)
    - In U.S. corner: ARI, ARAP, EPEE...
    - Go to www.arap.org for more info



Cooling Industry Direction

- Avoid over-sizing
  - Article by Mark Heizer, *HPAC Engineering*, May 2003
  - Article by Glenn Hourahan, *ARI Magazine*
    - Supplement to *HPAC Engineering*, May 2003
  - From the Editor, *HPAC Engineering*,
    - "Downside of Oversizing," May 2003
  - Not just cooling: boilers, fans, filters, valves...
  - Lots of reasons; really no longer valid
    - Trickiest is future growth... but
      - You're engineers!

Emerging Systems Concepts

- Energy-saving controls and pumping
  - Variable-Primary flow for lower first and operating costs
  - Reduces pump head (and pumps)
  - Higher delta-T performance
    - *HPAC Engineering* articles
    - *ASHRAE Journal* articles
  - This is the "hottest" cooling topic that I'm aware of

Emerging Systems Concepts

- All VFD-chiller plants for lower first and operating costs
  - Championed by Tom Hartman, PE
  - Some patent-pending aspects to Tom's no-PID-loop controls
  - *HPAC Engineering* (see references)
  - *ASHRAE Journal* articles

New Compressor Technologies

- Compressors
  - Turbocor Centrifugal Compressor
    - Demonstrated live at AHR Expo 2003
    - AHR Innovation Award for Energy, 2003
    - Magnetic bearings, VFD, advanced controls
    - R-134a refrigerant
  - Copeland Vapor-Injected Scroll
    - *ASHRAE Journal,* April 2003

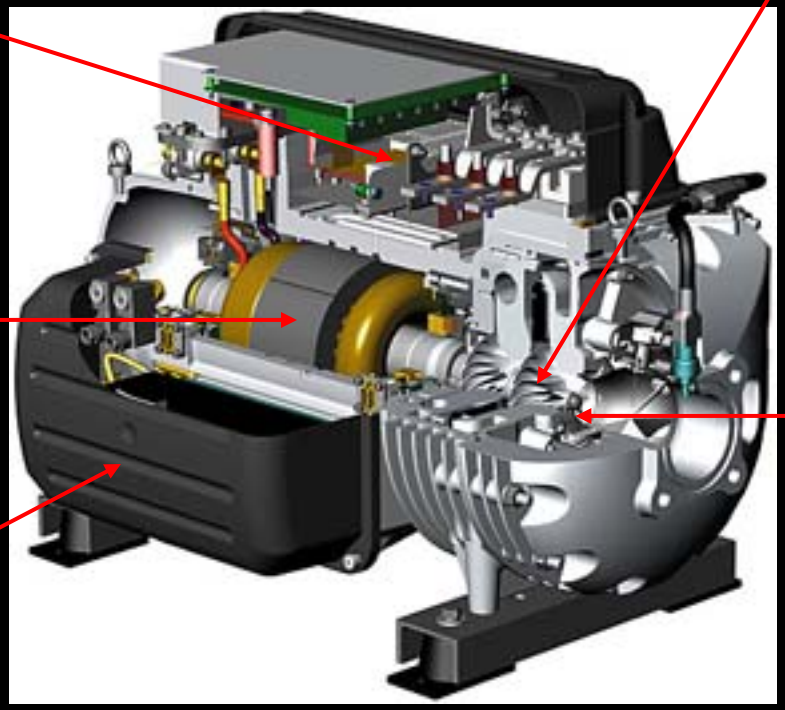
New Compressor Technologies

- Turbocor Frictionless Compressor
  - Very low noise, vibration
  - Has a soft-start, pulling only 2 amps
    - Typical screw compressor pulls 500 to 600 amps
  - Physical size is MUCH smaller
    - Weighs 1/5 that of a typical screw compressor
  - Has a built in VFD, inherent to design
  - 75 tons is only current size
  - Two can be linked together (more?)

New Compressor Technologies

2 stage, direct drive, hermetic centrifugal compressor

Inverter speed control



Permanent magnet motor

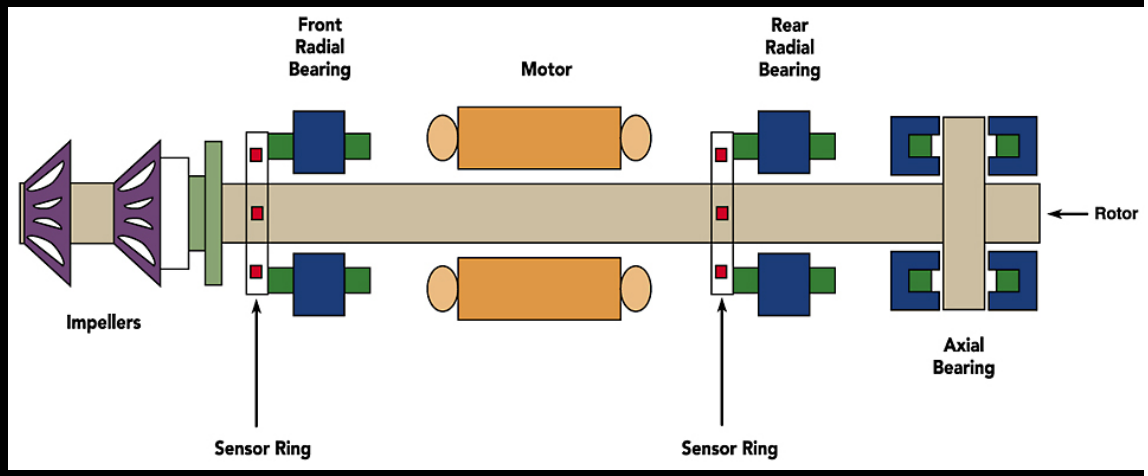
Inlet Guide Vanes

Motor and bearing control

Turbocor Compressor

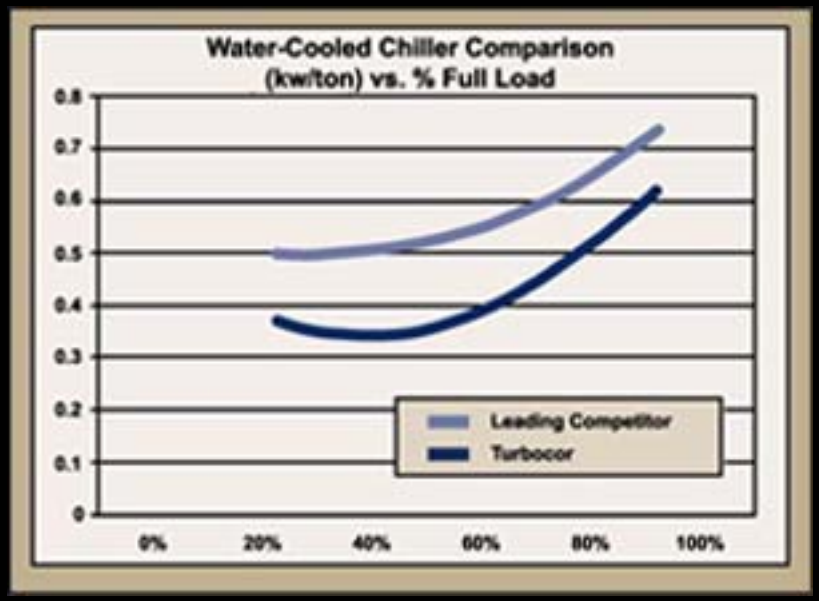
- The magnetic bearings have less than .2% the friction loss compared to conventional bearings

- Magnetic bearings and sensors keep the shaft properly centered and positioned at all times



New Chiller Technologies

- McQuay frictionless water-cooled chiller
  - ARI-certified 550/590 using two Turbocor TT-300 75-ton compressors

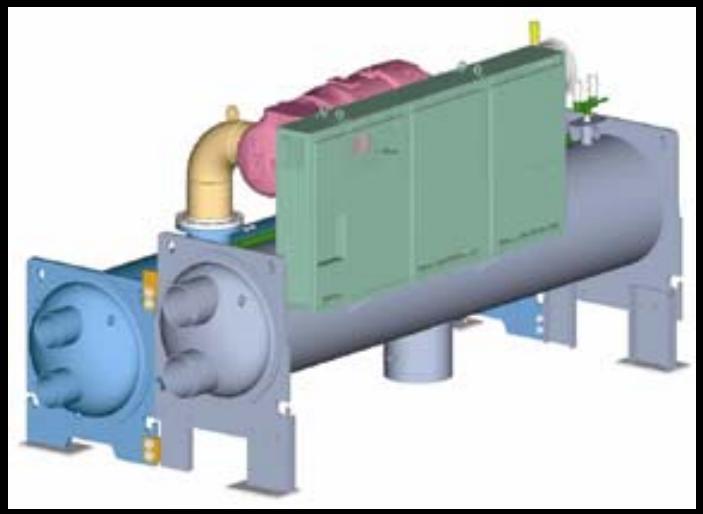


New Chiller Technologies

- Trane S-Series EarthWise CenTraVac
  - No oil or oil systems
  - R-123 is lubricant for high-tech bearings
    - SKF ceramic bearings in stainless steel raceways
  - Simpler design improves reliability
  - Tracer control panel comes standard
    - Meant to document energy performance
    - Future CO_2 emissions trading?
    - Also: alarming, trending, etc.
  - *HPAC Engineering*, June 2002

New Chiller Technologies

- Carrier Evergreen VSS
  - Variable-speed screw (standard)
  - Full-load below 0.52 KW per ton
  - IPLV estimated at 0.30 KW per ton
  - *HPAC Engineering*, June 2002
  - News: “soft delivery date” is 2004
  - Power factor: .99
    - Not .90
    - Smaller transformers
    - Happier utilities



New Chiller Technologies

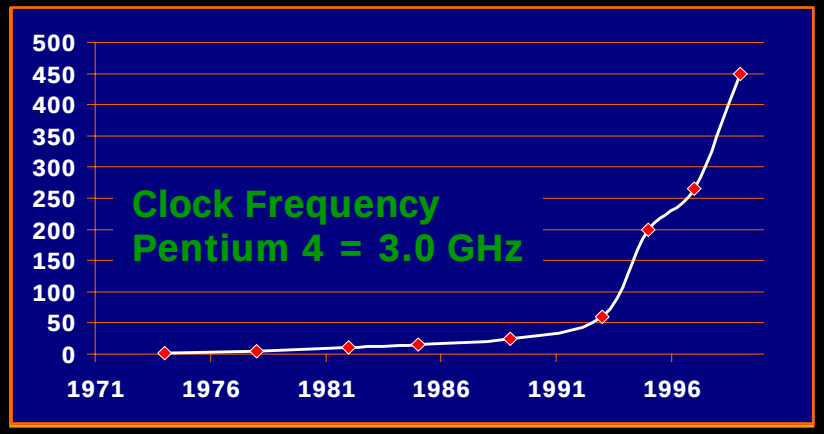
- Broad Spectrum LiBr Chiller
  - Full-load simultaneous cooling, heating, and hot water
  - Controls and mandatory maintenance prevent crystallization
  - Made in China
  - U.S. installations
  - *HPAC Engineering*, May 2000
  - Huge range: 33 - 2,600 tons
  - COP stated to be 1.34
  - Gas- or oil-fired
  - Continuous evolution
  - Go to www.broadusa.com

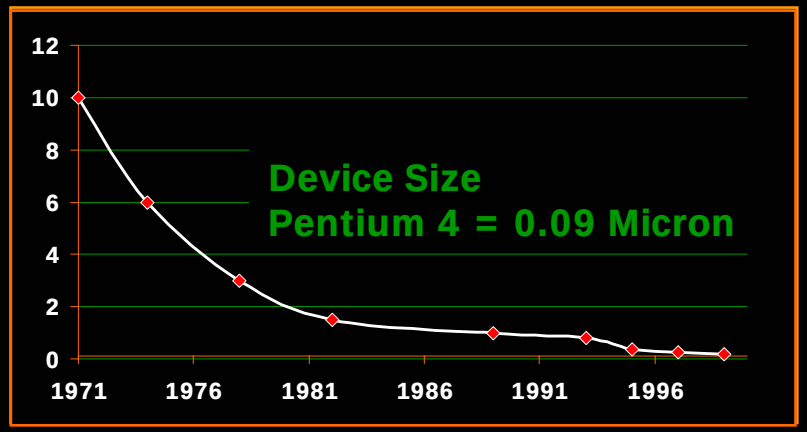
New Chiller Technologies

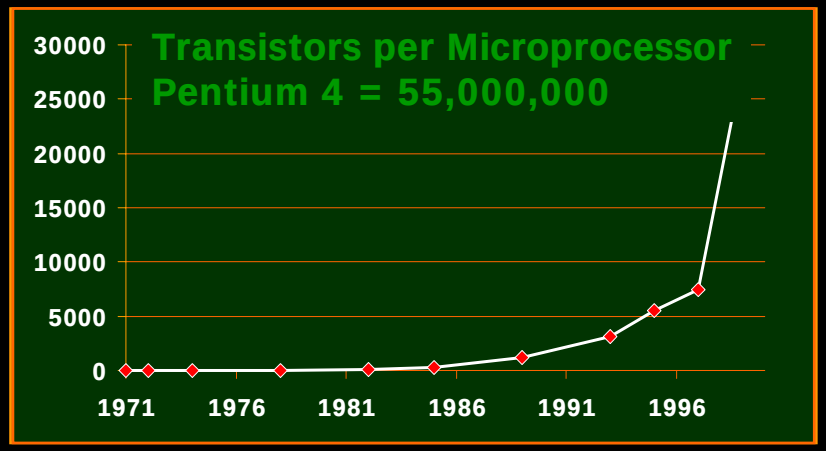
- York *Opti-Speed* and *Opti-View* technologies
  - Opti-Speed VSD controller
    - York's Adaptive Capacity Control (ACC) "learns optimum chiller runtime conditions by experimenting with run speed and vane positions...to minimize electricity usage"
  - Opti-View
    - Graphical user interface for real-time display of operating and trend data
    - Retrofits available for Carrier, Trane, and McQuay chillers

Data Centers are a Growing Challenge

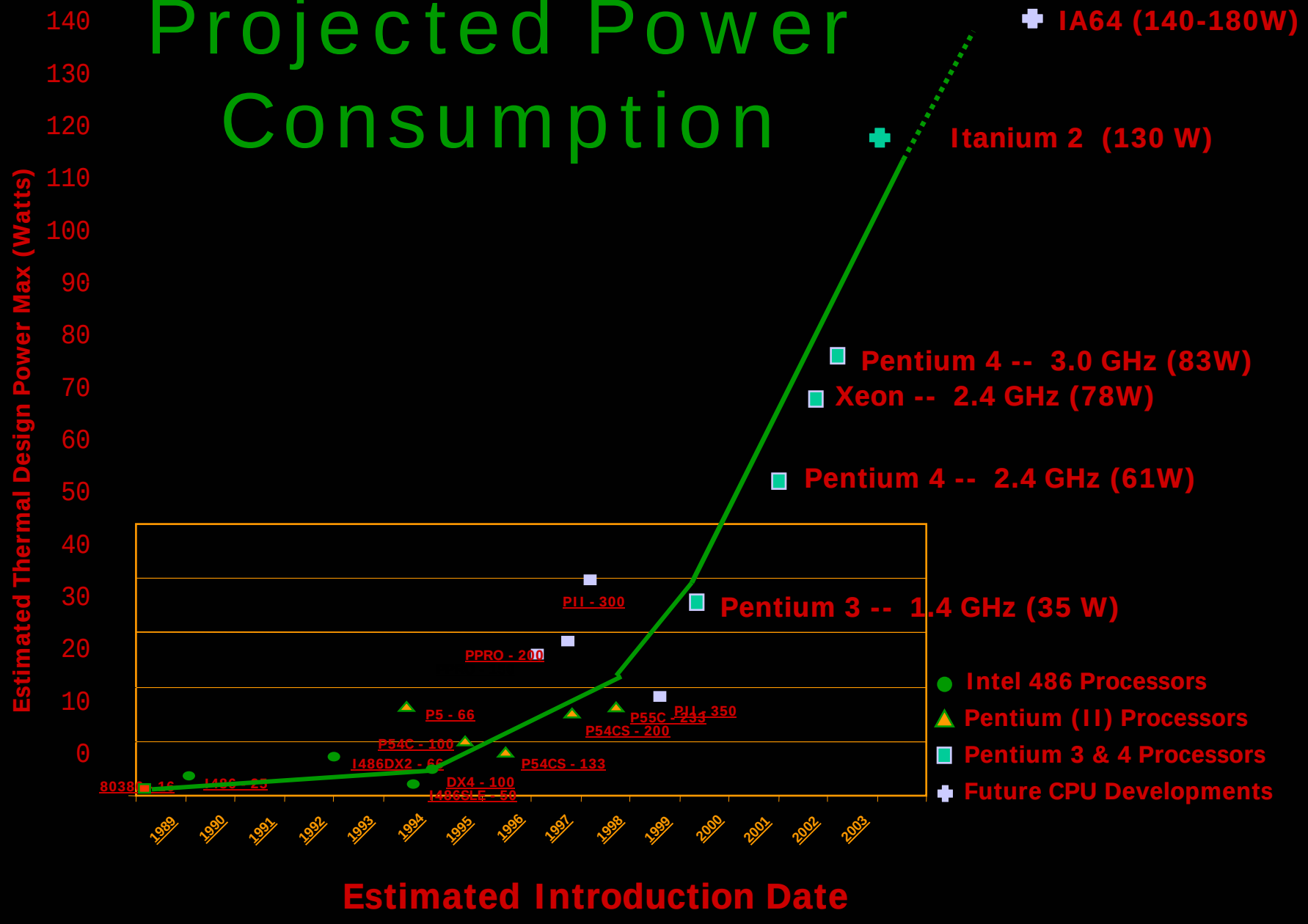
- High (Extreme) -density cooling
  - For data centers and telecomm facilities
  - Nanotechnology to the rescue?
    - On-board cooling
    - Self-cooling chips



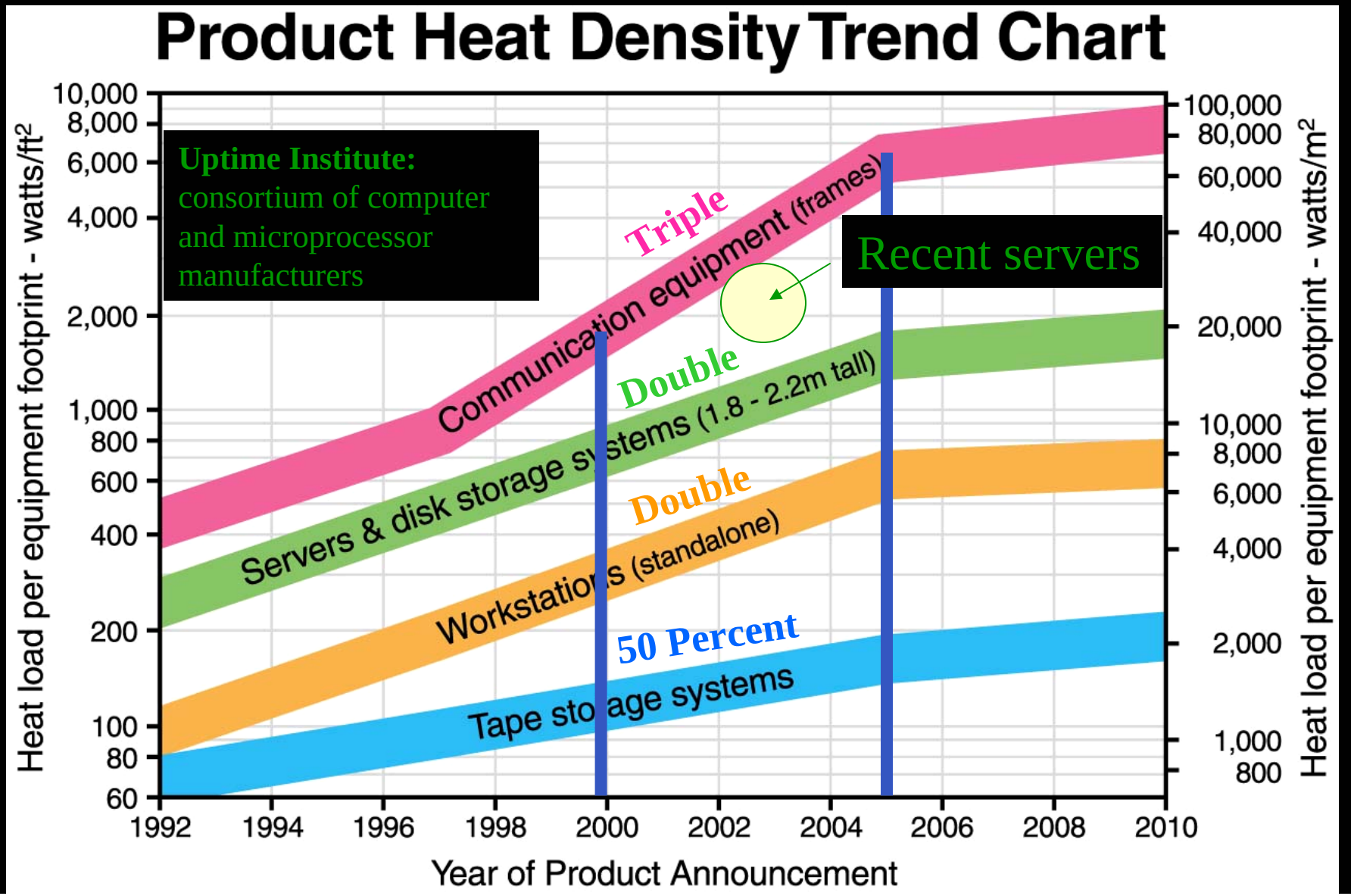




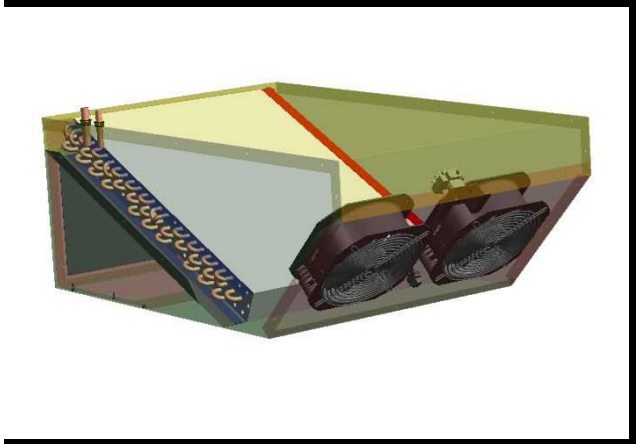
Projected Power Consumption

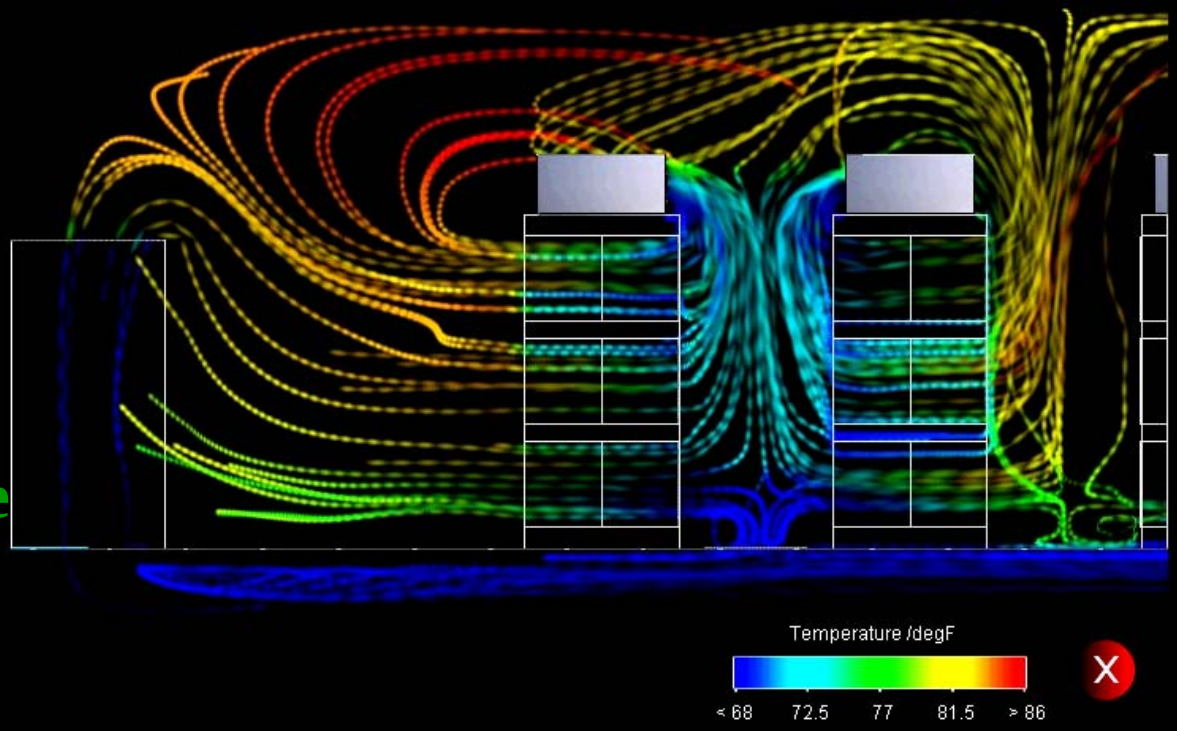


Emerging Systems Concepts



One Approach: Liebert XDV





- **Rack-mounted**
- **Virtually no floor space**
  - **A premium!**
- **Refrigerant cooled**

Something Different

- RediControls Refrigerant Purger
- Removes oil, acid and moisture from chiller's refrigerant charge
  - (to trace levels)
- Now available for low-pressure and high-pressure centrifugals
- Soon for high-pressure screws
- Saves energy (oper. costs)
- "$24,000 per year per chiller"
- "3-to-4 month payback"

Conclusions

1. Regulations driving energy efficiency up and emissions down
2. Loads getting smaller (office buildings) as equipment, buildings get greener
3. Loads getting higher (data centers) as computers decrease in size but increasing in power/heat intensity
4. Chillers getting smaller, simpler, more flexible
5. Controls and piping/pumping methodologies are getting more complex

Thank You

Send comments,
suggestions,
questions, and
pointed anecdotes to
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