LOEWE-CSC and it’s data center
Sieger in der Kategorie 3
Visionäre Gesamtkonzepte
(System und Prozessgestaltung)

CSC – Center for Scientific Computing

GreenIT BEST PRACTICES
/ LOEWE-CSC /

Heat Transmission via Air and Water

Required Volumetric Current:

\[ Q = \dot{V} = \frac{P}{c_p \cdot \rho \cdot \Delta T} \]

- \( P \): Thermal Power Loss
- \( \Delta T \): Temperature Difference

### Air
Specific Heat Capacity: \( c_p = 1.005 \frac{kJ}{kg \cdot K} \)
Density: \( \rho = 1.184 \frac{kg}{m^3} \) (Standard Conditions)

Example: Notebook-Computer (30 W)
- Room: 25 °C
- max. 50 °C
\[ \Delta T = 25 K \]
\[ \Rightarrow Q = 1,0 \frac{m^3}{s} \]

### Water
Specific Heat Capacity: \( c_p = 4.183 \frac{kJ}{kg \cdot K} \)
Density: \( \rho = 997,0 \frac{kg}{m^3} \) (Standard Conditions)

Example: Data Center (1 MW)
- Supply Air: 18 °C
- Exit Air: 43 °C
\[ \Delta T = 25 K \]
\[ \Rightarrow Q = 33.600 \frac{m^3}{h} \]

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Cooling System Architecture

data center building

server room

draw-off

evaporation

cooling tower fixtures

makeup water

equipment container

Primary Cooling circuit

Secondary cooling circuit

secondary pump

heat exchanger

primary pump
Feuchtkugeltemperatur 2010

![Graph showing temperature and humidity over the year 2010. The graph includes lines for atmospheric humidity, ambient temperature, and wet bulb temperature, with data points plotted for each month.]
LOEWE-CSC Cooling

- Max cooling power: 600 kW
- Secondary pump: 28 kW
- Primary pump: 6 kW
- Cooling tower Fans: 2x4.5 kW
  not required if outside temperature below 15 °C

→ PUE (best): 1.05
→ PUE @ 450 kW: 1.07

- Server fan overhead: 6%
LOEWE-CSC Green-IT

Klärschlammverbrennungsanlage

Biogasanlage

Chemieproduktion

Ersatzbrennstoffanlage (EBS) In Umsetzung

2. & 3. Gasturbine In Umsetzung

PUE 1,08

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Green500: 10 → 41 (!)
Top500: 22 → 33
Cost: 200 €/core
CO₂ neutral
Local had drives: 1.62 PB
Core memory: 55.8 TB
Nodes: 830
Mass storage: 420 TB (net)
CPU cores / GPUs: 20880 / 772
Power: 500 kW
Cost: 4200 k€ net; 200 €/Core

Cool-Overhead: 7%
DGEMM GPU: 494  Gigaflop/s (90.8% peak) world wide fastest
System LINPACK: 299  Teraflop/s
Compute power/W: 736.8  Megaflops/w

CO₂ Saving / year: 8,000 T
DGEMM Scalability

Optimized HPL for AMD GPU and Multi-Core CPU Usage, ISC June 2011
Next Generation Data Center

FIAS Patent submitted @ DPMA/PCT 5.7.2008 (Lindenstruth, Stöcker)
Conclusions, Outlook

- Indirect passive cooling generates very efficient cooling of PUE<10% in European climate
- Ambient temperatures in Germany support entire year operation
- Any commercial servers are supported
- No active components in the data center
- No air ducts of any kind
- Highest power density of 20kW/m² per floor
- Efficient programming one of the largest savings potentials
Questions?