

ColdCon[®] Hotwatercooling – Made in Germany

Expansion Stage 2013



Jörg Heydemüller



Company Profile



- established in 1990
- german private limited company
- more than 10 years in Europe
- specialised in supercomputing systems
- unique product portfolio
- financially strong

ISO 9001 + ISO 14001 certified
2 Million Euro authorised capital
„the“ German Supercomputing specialist
50 employees



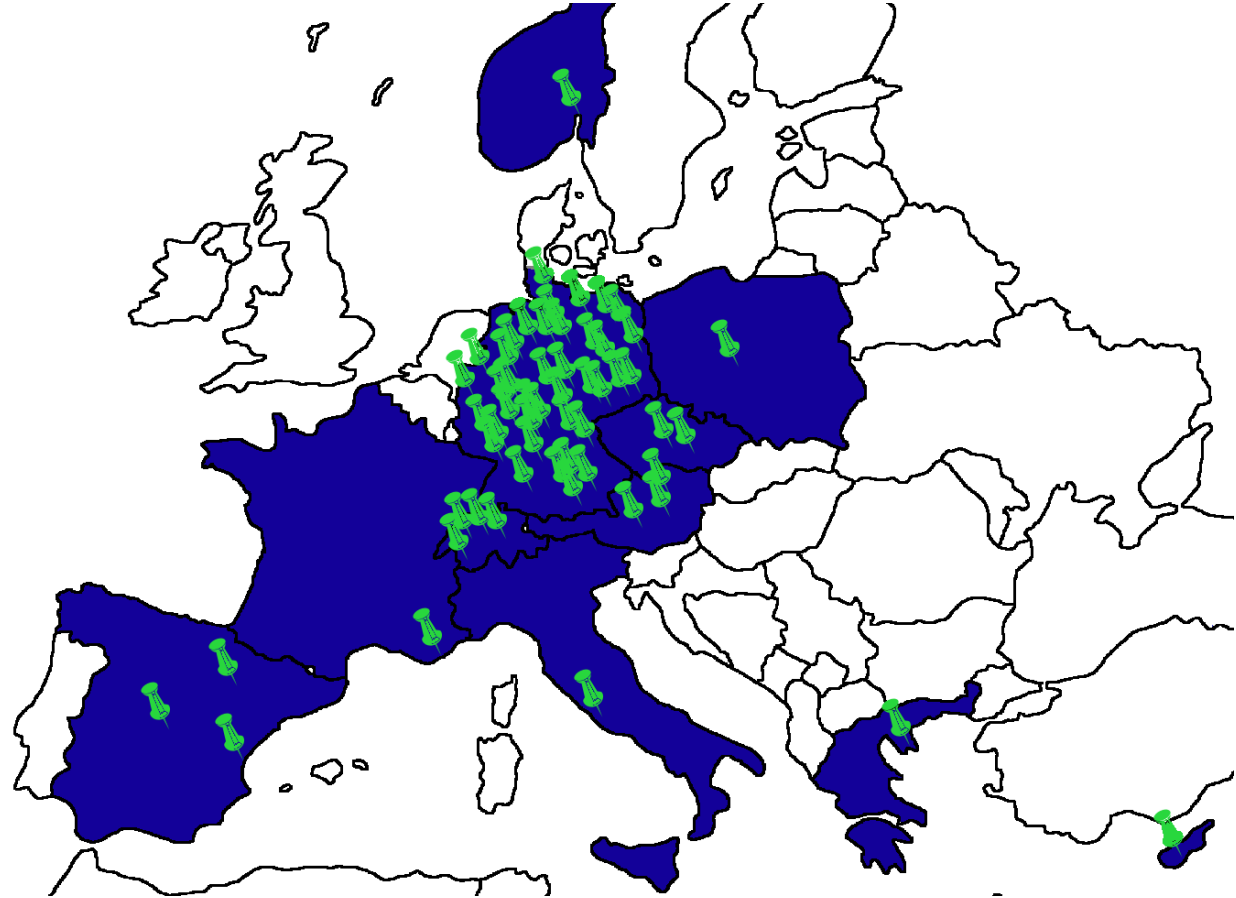
Chemnitzer Linux Cluster (CLiC)

- in the year 2000 Prof. Hans-Werner Meuer:
"the worldwide best price performance ratio"
- TOP500: Position 126 (June 2000)
- 528 nodes INTEL Pentium III 800 MHz
- performance 143,3 GFlops



650 Installed Systems in Europe

- Norway
- Austria
- Abu Dhabi
- Greece
- Poland
- Czech Republic
- Cyprus
- Switzerland ...



„VSC-2“ Vienna Scientific Cluster

- Austria's fastest HPC System
- **Top500 Position 56** (June 2011)
- 1314 nodes in 30 Knürr® CoolDoor® passiv Racks
- Processor Cores: 21.024
AMD Opteron 6132HE – 2.2GHz
- QDR Infiniband
- 12 Storage Server (216TB)
- FhGFS parallel Filesystem

Budget: ~5 Mio. Euro



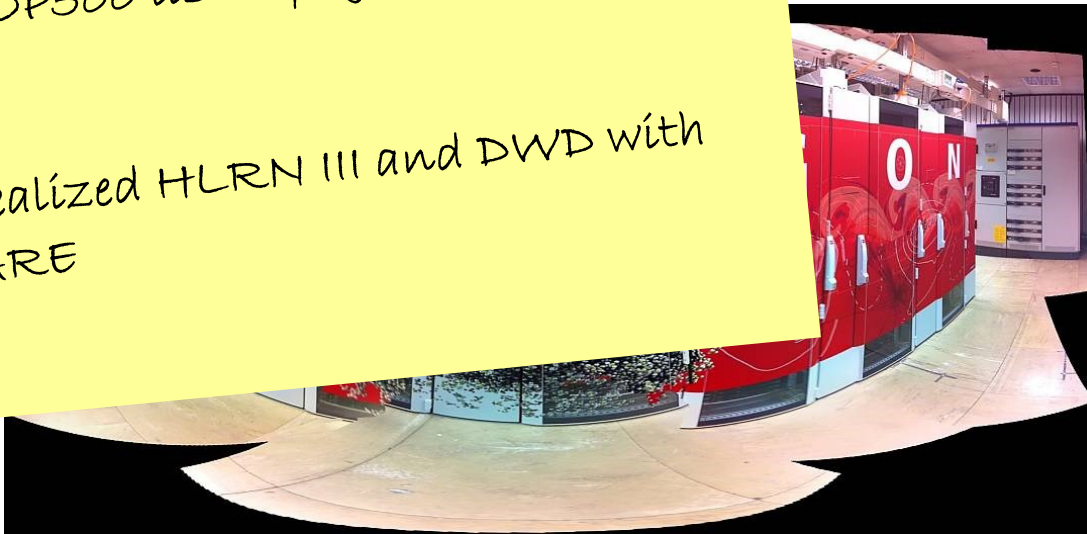
- Supercomputer in Norway
- **Top500: Position 96** (June 2011)
- 664 nodes in 23 Racks
- 10.500 Processor Cores
INTEL Sandy Bridge E2670
- FDR Infiniband
- FhGFS parallel Filesystem
- 178,3 TeraFlop/s



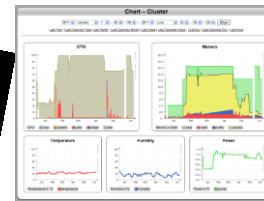
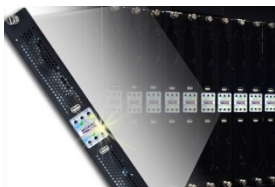
- Rhineland-Palatinate fastest HPC System
- **Top500: Position 81** (June 2012)
- 535 Nodes in 14 Racks
- Processor Core...
- AMD Opteron
- QDR Infiniban
- 205 TeraFlop/s

2013...
University of Bayreuth is one of the 4
current TOP500 listed projects... ~
100TFlop

CRAY realized HLRN III and DWD with
MEGWARE



- MEGWARE Chassis since 2001: Slash2/Slash5/Slash8
- MEGWARE ClustSafe PDU since 2003: CS12/CS18
- MEGWARE Rack Display for Monitoring: RackView®
- MEGWARE Management / Monitoring Software: ClustWare®
- MEGWARE Direct Water Cooling: ColdCon/ClustCool®



As part of the prototyping Objective #2

“European HPC Technology Developments“

Prototype development with

energy reuse

Energy expense

water at 30 °C

Energy expense

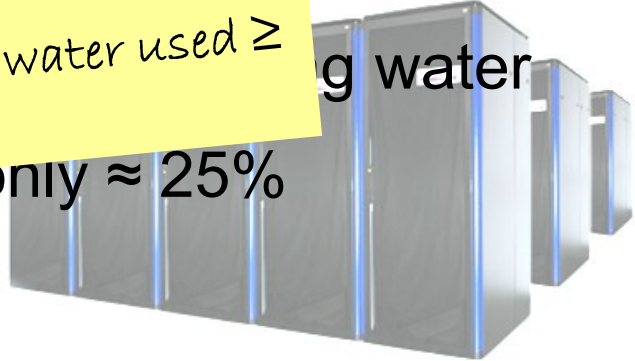
above 30 °C

The tender called for a direct liquid cooling of all essential elements
cooling water $\geq 30^\circ\text{C}$ and a temperature spread of $\Delta T = 6\text{K}$
The heated return water should tiles with at least $\geq 36^\circ\text{C}$ back
“bonus points” when the cooling water used $\geq 38^\circ\text{C}$ or more...
... then only $\approx 25\%$

ing and

f cooling

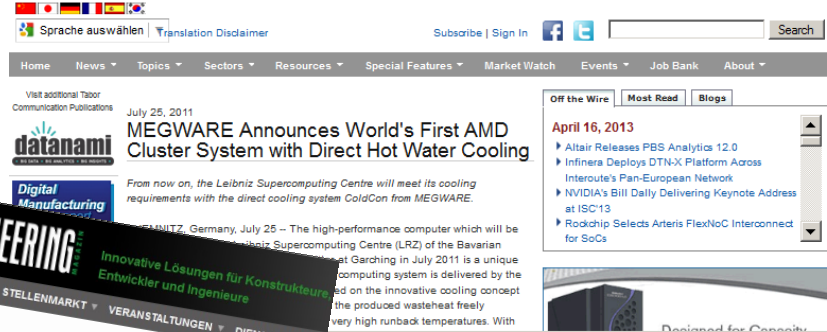
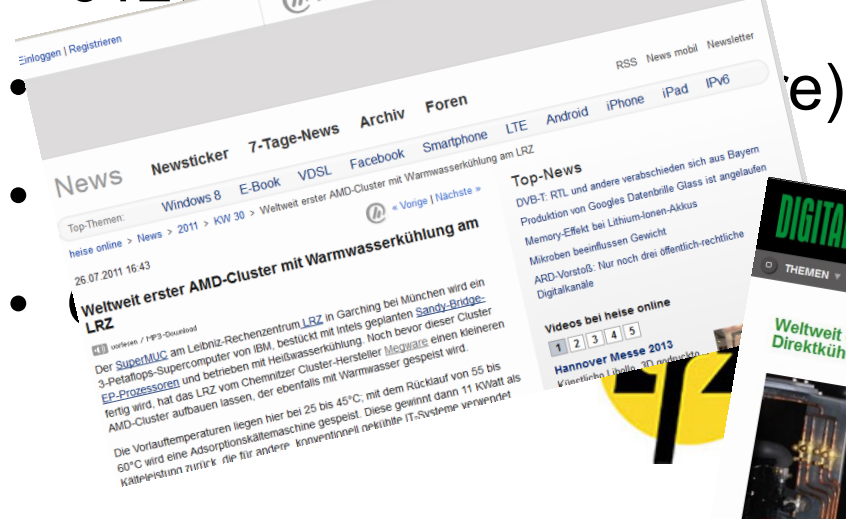
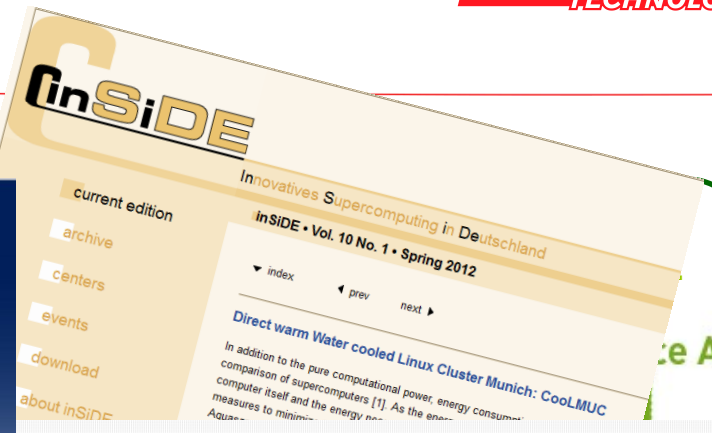
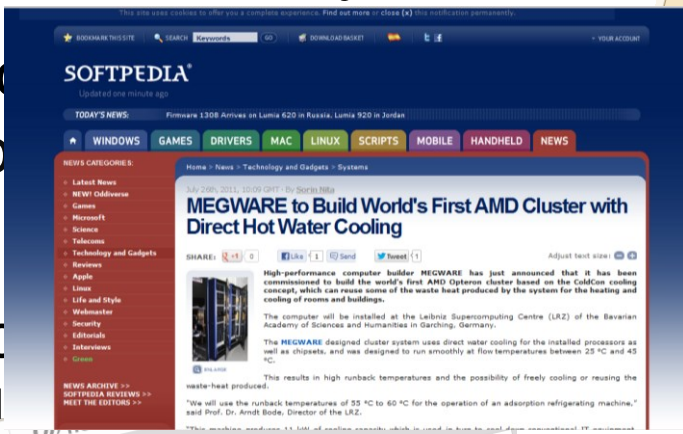
g water



ColdCon® Project at LRZ Garching

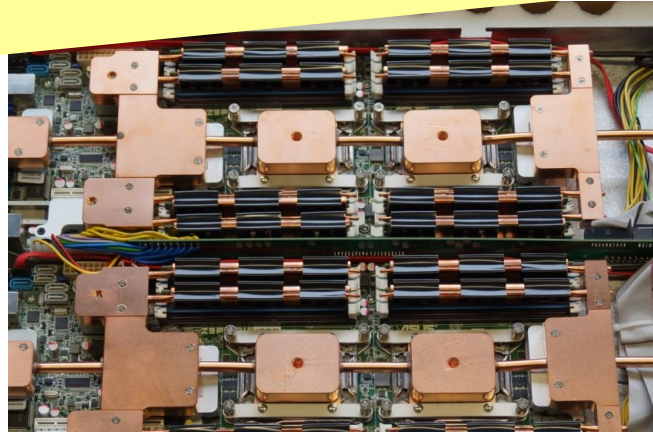
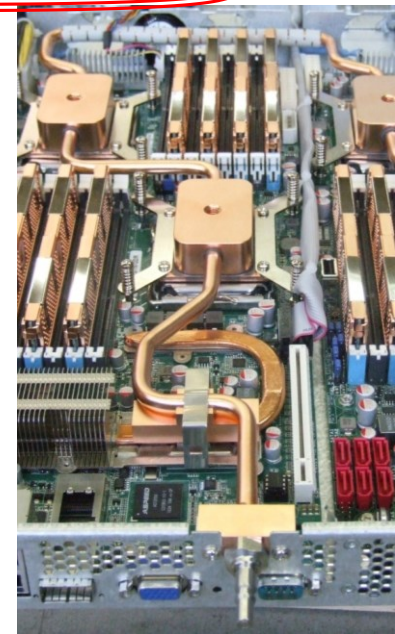


- World's first directly water-cooled
- ColdCon
- > Cop
- 178 Cl
- DualIn
- 6128H

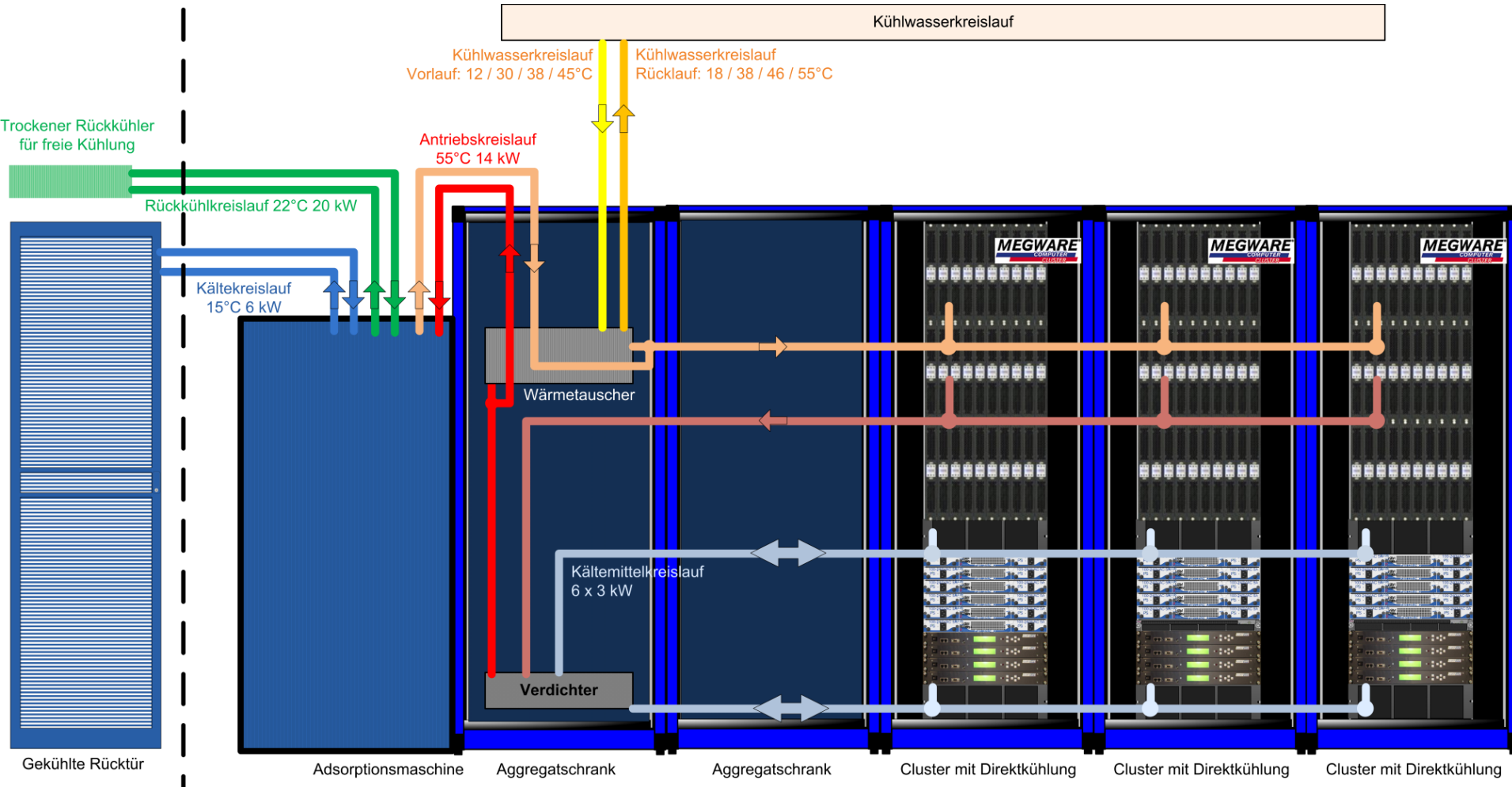


- direct water cooling of 4 CPUs & 2 chipsets
- over 75% of the heat is removed
- 0.4 to 0.5 W/K
- $\Delta T \approx 5K$
- only 1 fan per rack
- solid copper
- no leakage possible
- drop free couplings
- easy service during operation

Upgrade 2012!!!!
One more Rack...
ColdCon vers.2 - enhanced cooling
all DIMMs via heatpipes
CPU voltage regulator and IBC chip +
QSFP connector
90% heat removal
now all fanless



ColdCon® Project at LRZ Garching



03.09.2013

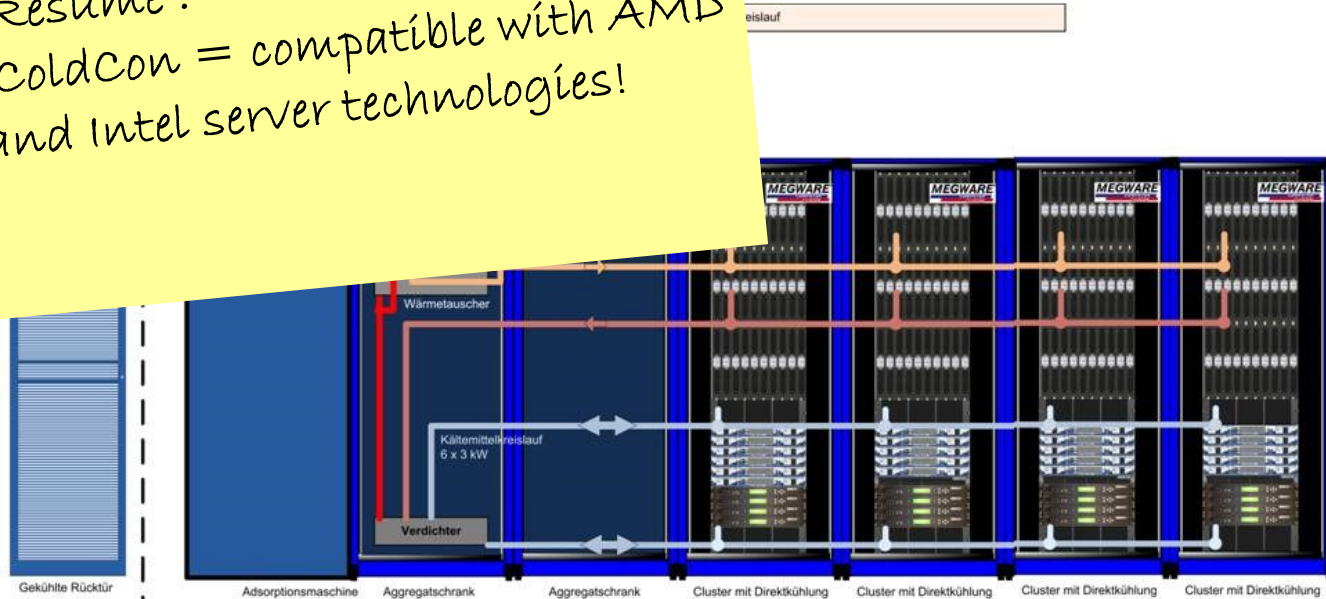
- separate coolant circuit
- no water
- refrigerant evaporator RCL
- up to 7 kW cooling capacity



Extension 2012

- additional rack with 61 nodes
- Intel Xeon E5-2670 2.6GHz 8-core
- Samsung 16GB DDR3
- ... in the cooling circuit

Resumé :
ColdCon = compatible with AMD
and Intel server technologies!



System Security

- emergency cooler with heat exchanger 30 kW
- mechanical temperature sensors (sub-distribution)
- electronic sensors (ClustSafe)
- Monitoring by ClustWare® Appliance

individual nodes can be taken out during operation

Coolant non-toxic, non-corrosive and non-flammable



Energy Balance savings

- no more fans with 30W per node ≈ 5 kW savings
- energy consumption for water below 30 ° C $\mapsto 1.46$ kWh/m³
 $\Delta T=6K$, 45 kW consumption $\mapsto 6.5$ m³ of water per hour
 $6.5 \times 1.46 \approx 9.4$ kW savings
- no radiator fan at the back of the cabinets
1.5 kW per cabinet ≈ 4.5 kW savings
- adsorption engine:
energy consumption for water below 30 ° C $\mapsto 1.46$ kWh/m³
 $\Delta T=6K$, 8 kW consumption $\mapsto 1.15$ m³ per hour
 $\approx 1,7$ kW savings



Energy Balance: **effort**

- energy required for cooling water above 30 ° C
↳ 0.36kWh/m³
ΔT=6K, 45 kWh consumption ↳ 6.5 m³ per hour
≈ 2.3 kW effort
- cooling technology (pumps, compressors and RCL):
2.4 kW effort
- adsorption: energy required for cooling water above 30 ° C
↳ 0.36kWh/m³
ΔT=6K, 8 kW consumption ↳ 1.15m³ per hour
≈ 0,7 kW effort



Energy Balance: Final

- 5 kW+ 9.4 kW+ 4.5 kW+ 1.7 kW \approx 20.6 kW savings
- 2.3 kW+ 2.4 kW+ 0.7 kW \approx 5.4 kW effort
- 15.2 kW total saving



15.2 kW savings x 0,15 € / kWh
counted for 5 years

 \approx 100.000 €!!



ColdCon® Vers.3 up to 2013!

confidential

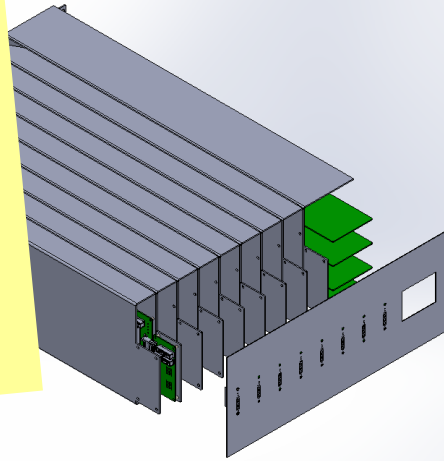


- MEGWARE SlashX® - new HPC compute platform!
- support standard air and direct liquid cooling as alternative same chassis for both options!
all components direct liquid cooled including CPUs, VR, DIMMs and chipsets including IB connector

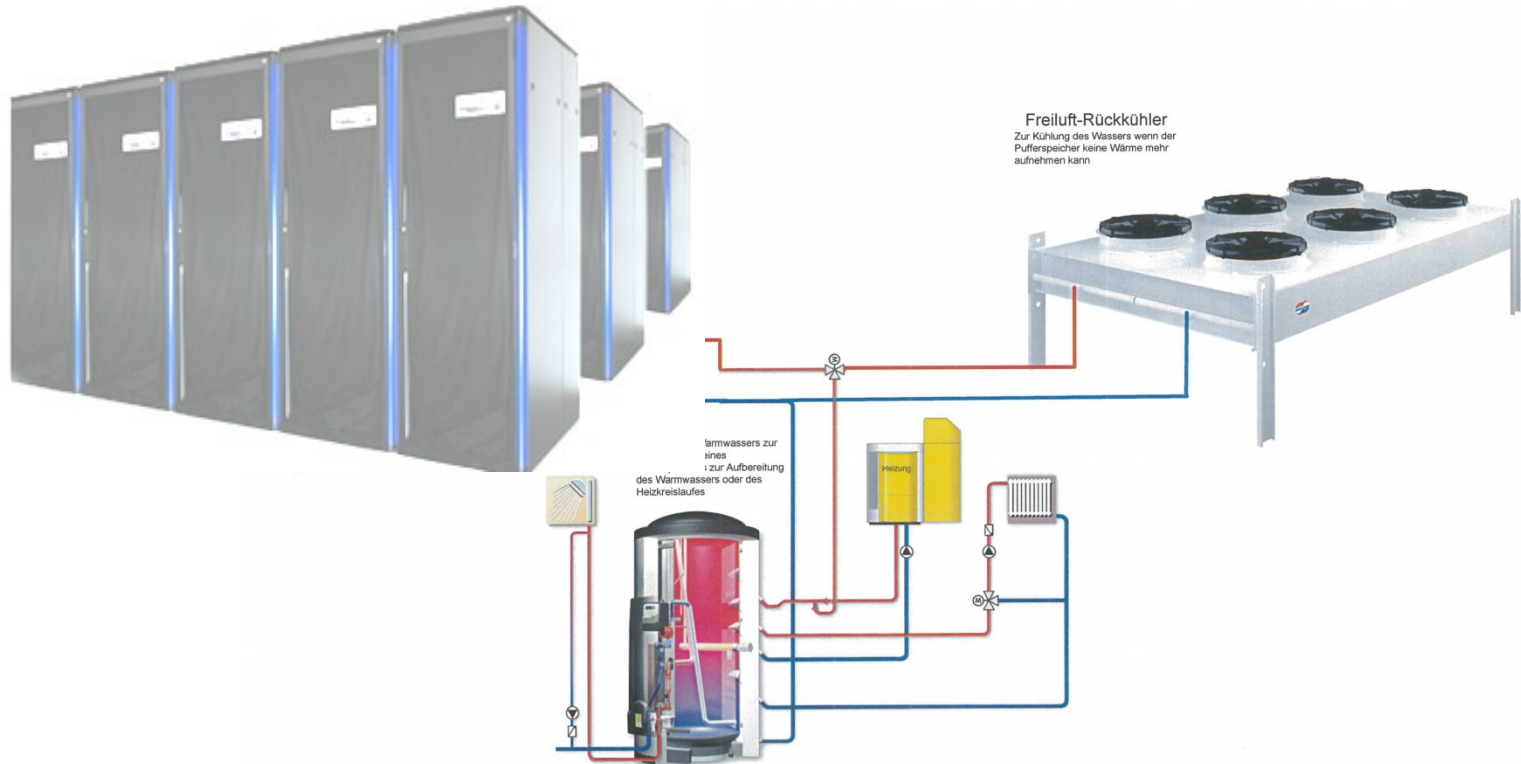
- up to 10 compute accelerators
- up to 80 compute nodes per 19" rack
- power supply for redundant

standard configuration: 3 + 1 for 10 compute nodes
 performance configuration: 4 + 1 for double compute nodes
 PMBus Management and additional control functions engineered by MEGWARE
 detailed power monitoring with up to 1000 samples on DC side for 5V and 12V

nodes with



- Next installation will realized at a North German university!



- With the aim to integrate the waste heat water in the normal water heating cycle.

- visit the MEGWARE part of `Atlas` Supercomputer here at the University of Dresden

processor Type : AMD Opteron 6274 2,2 GHz

number of processor 2016

Interconn

power sup

Thank you!



- meet us at SC Denver 2013

