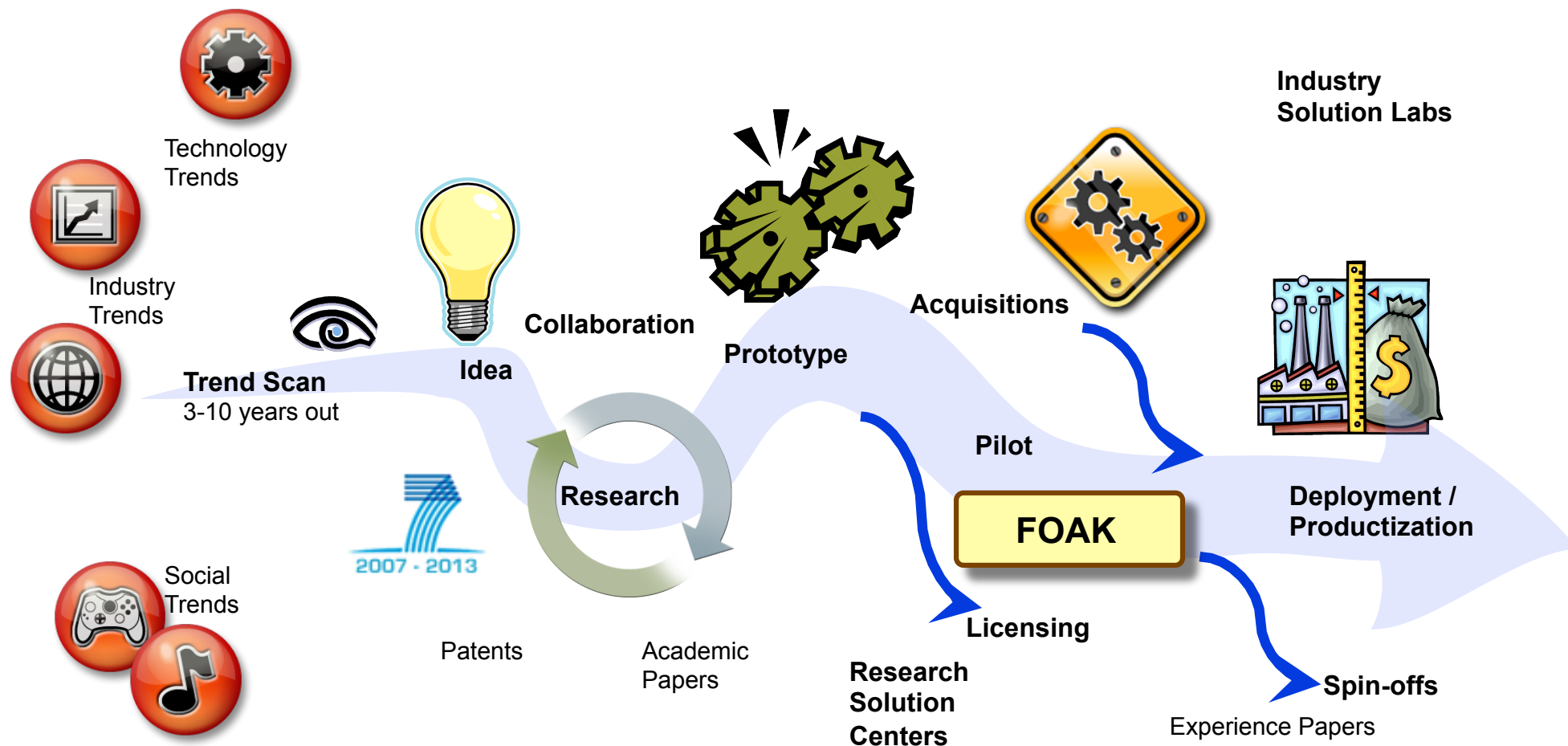


# Meet Aquasar:

A first a kind hot-water cooled supercomputer



# Aquasar was born from a process of innovation and...



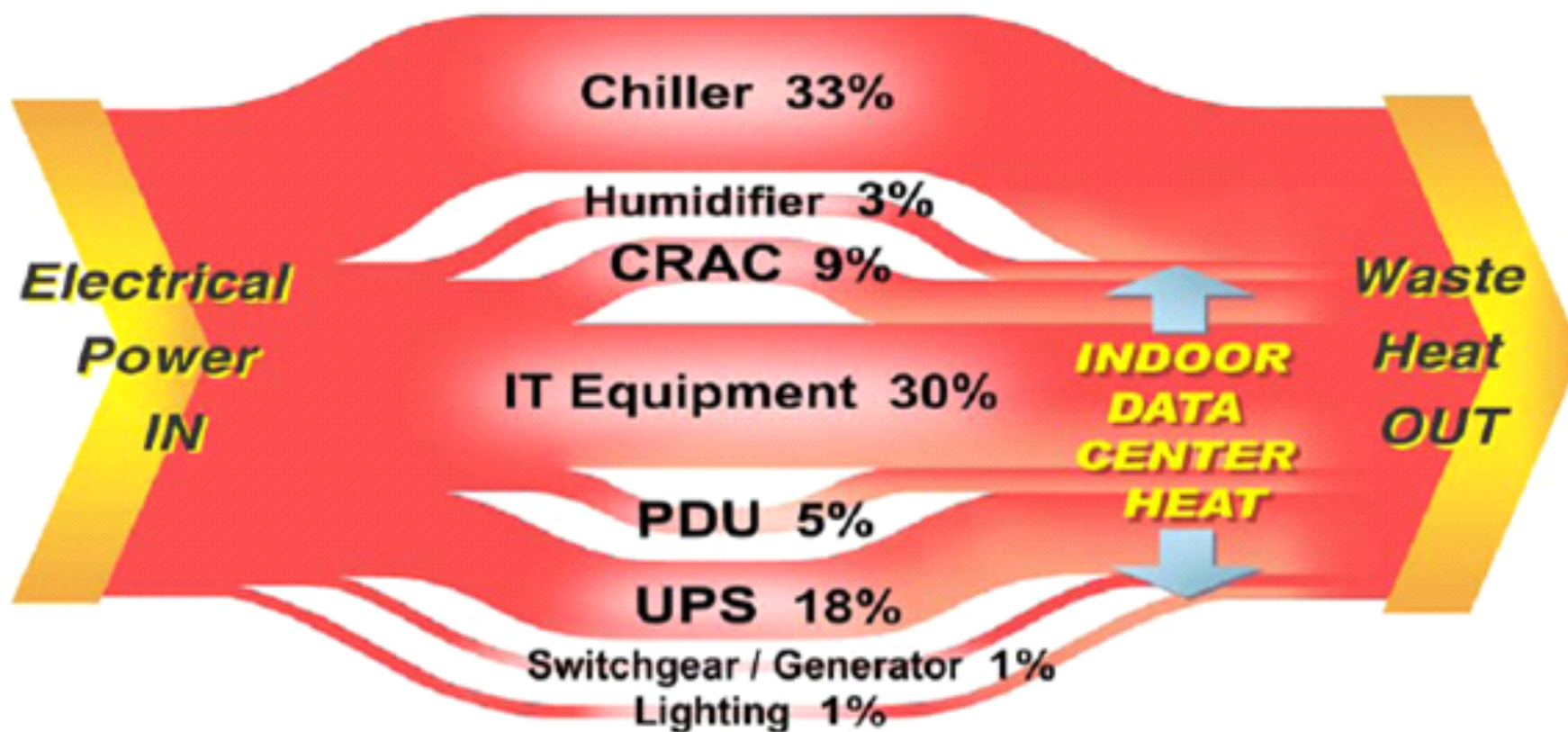
... because Mother Nature and clients demanded it.

- **FINANCIAL:** Rising global energy costs/ Shrinking IT budgets / IT capability does not align with business plan
- **OPERATIONAL:** Proliferation of IT technology in the data center, the Age of Cloud Computing is growing
- **ENVIRONMENTAL:** Large carbon footprint and poor corporate image on energy consumption are of growing concerns



## Where does all the energy go?

ICT industries consume 2% world wide energy supply



Brouillard, APC, 2006

# Aquasar Timeline

**2007**

IBM scientists develop concept of a zero emission data center



**2008**

The concept is unveiled for the first time at Cebit in Hannover, Germany, to positive reviews



**2009**

ETH and IBM announce plans to build Aquasar, a water cooled supercomputer and directly repurpose excess heat for the university's buildings

**ETH**



**2010**

Aquasar comes to life for the first time in front of dozens of reporters at ETH

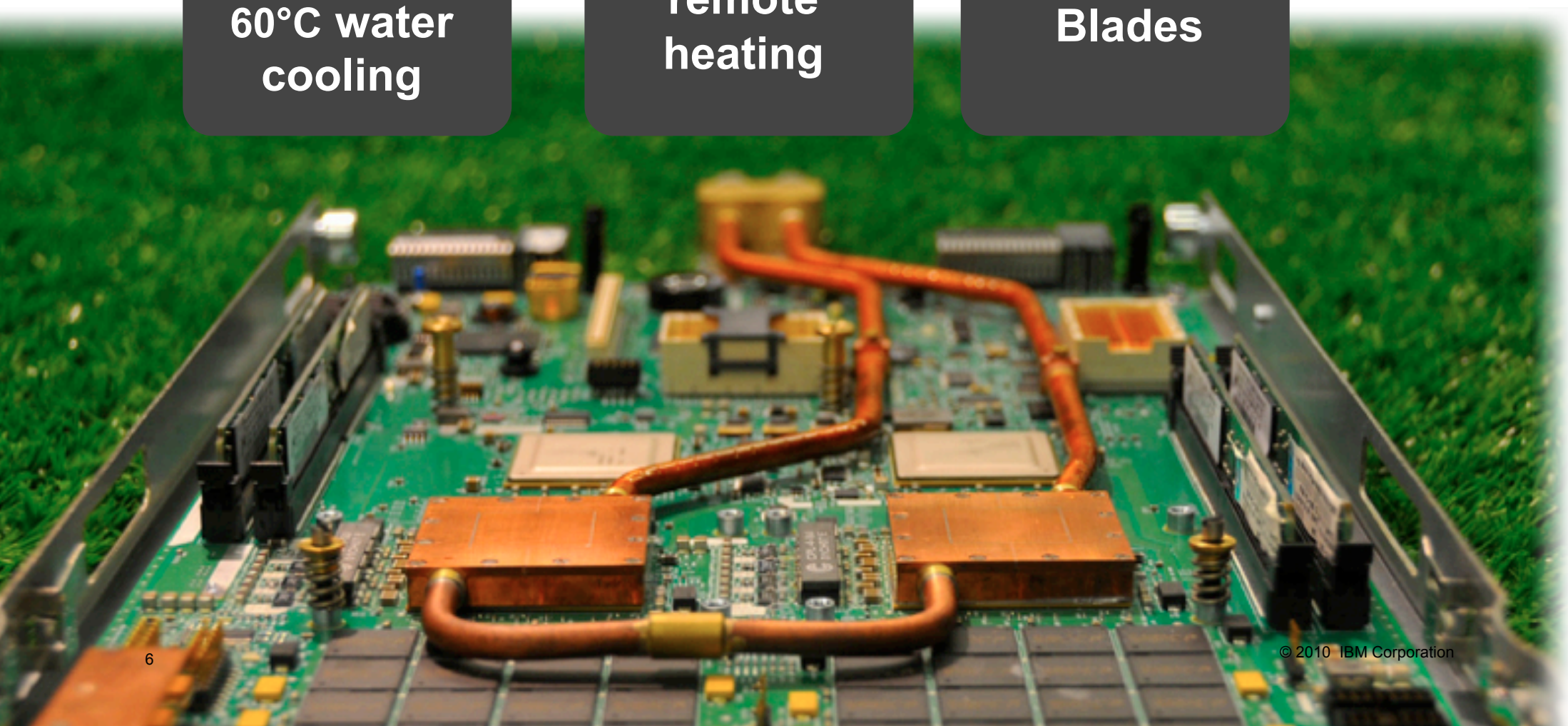


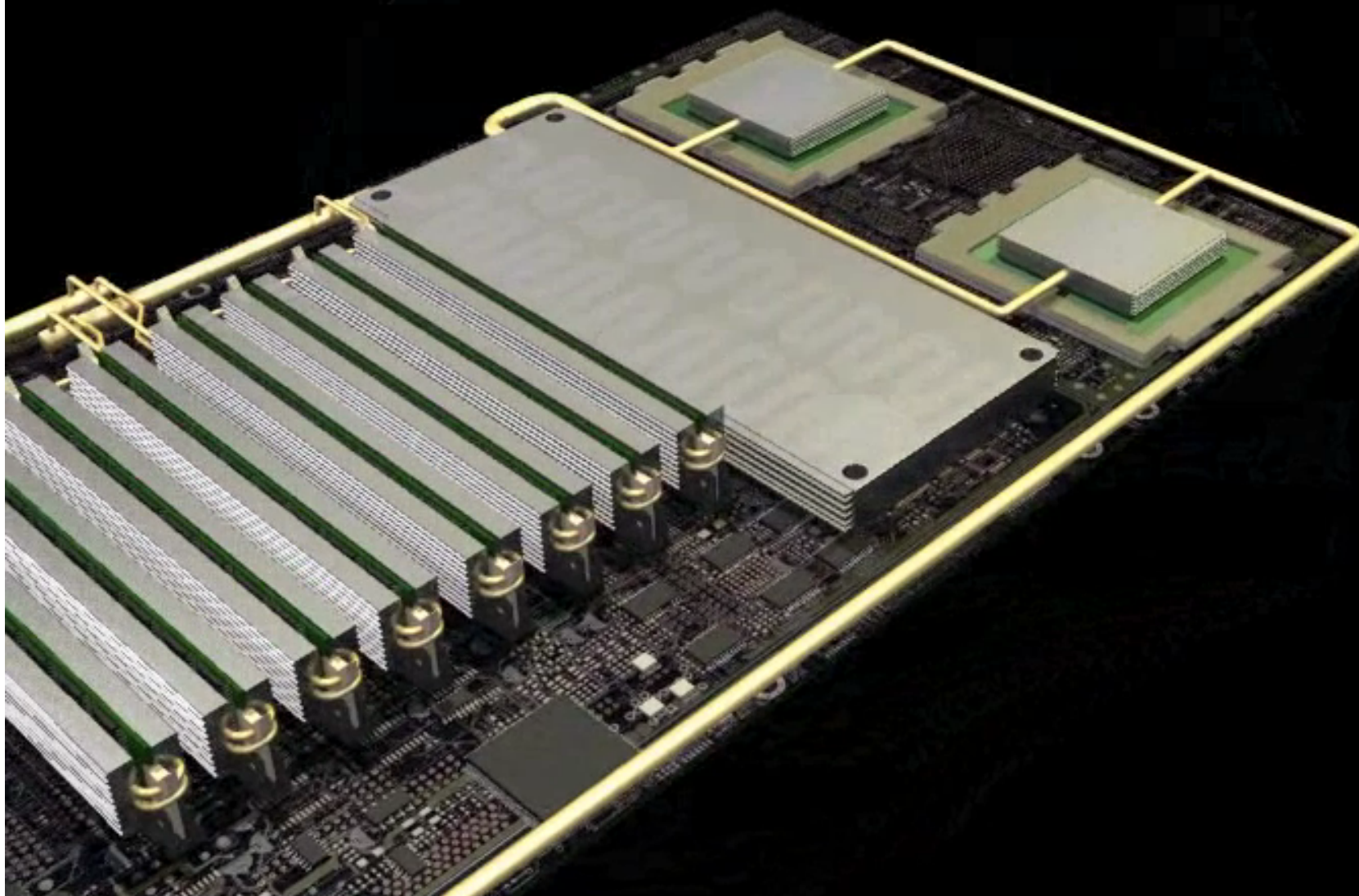
## First Aquasar Prototype

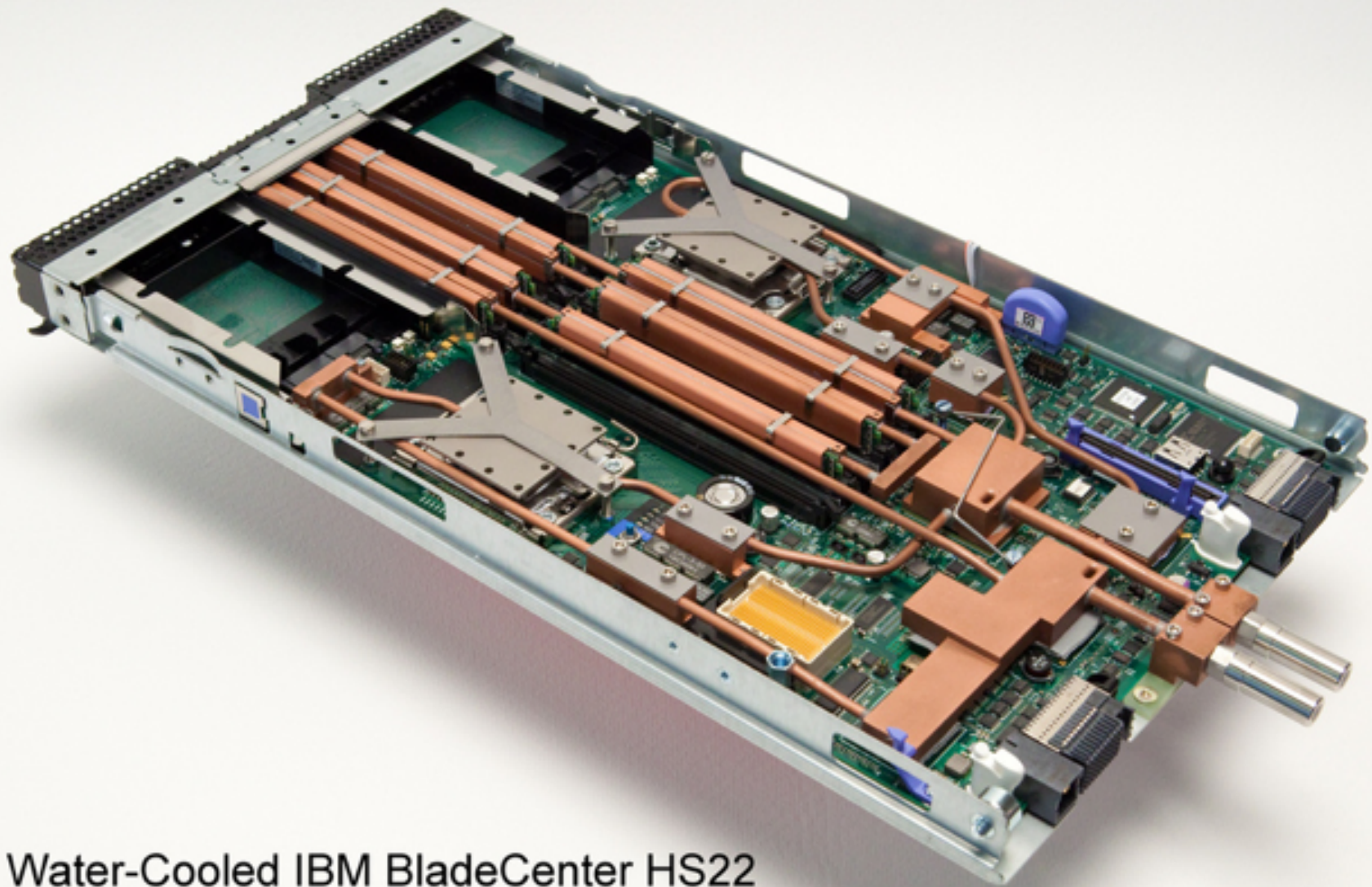
**Reduced  
cooling  
energy with  
60°C water  
cooling**

**Reuse waste  
60°C heat for  
remote  
heating**

**Built using  
standard IBM  
Blades**







Water-Cooled IBM BladeCenter HS22

Credit: IBM Research – Zurich

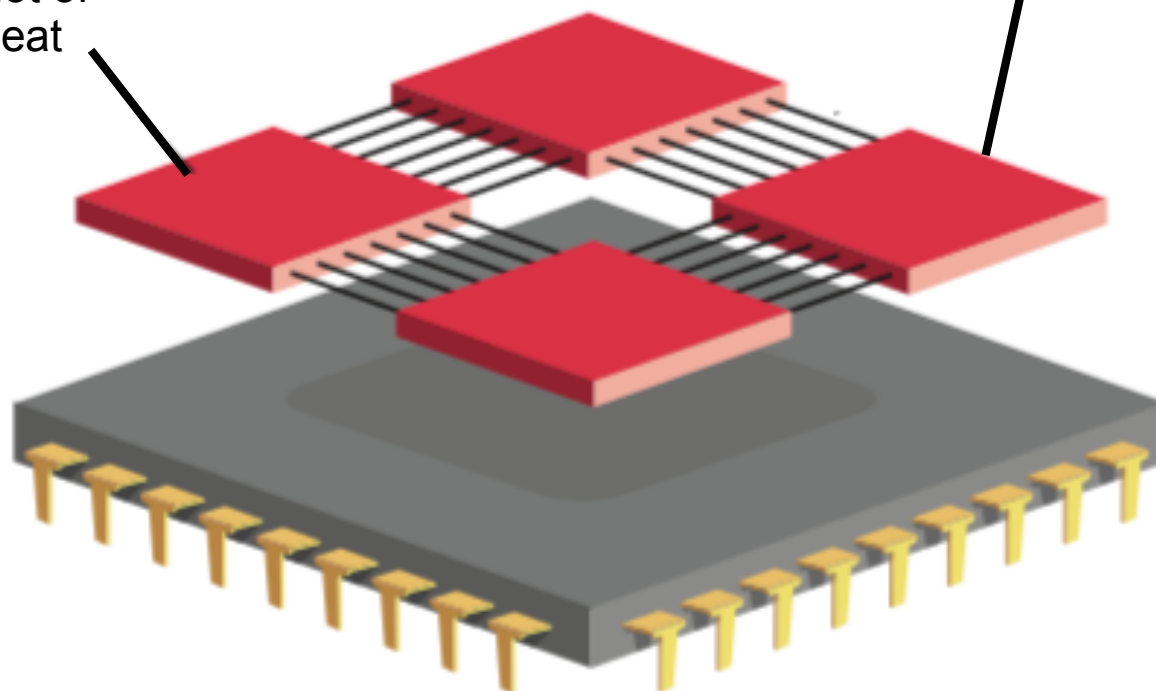


## What's next?

### Today's Microchips

**Cores:** this design consumes a lot of energy and heat

**Cables:** The cores are placed next to each other and communicate via interconnected cables

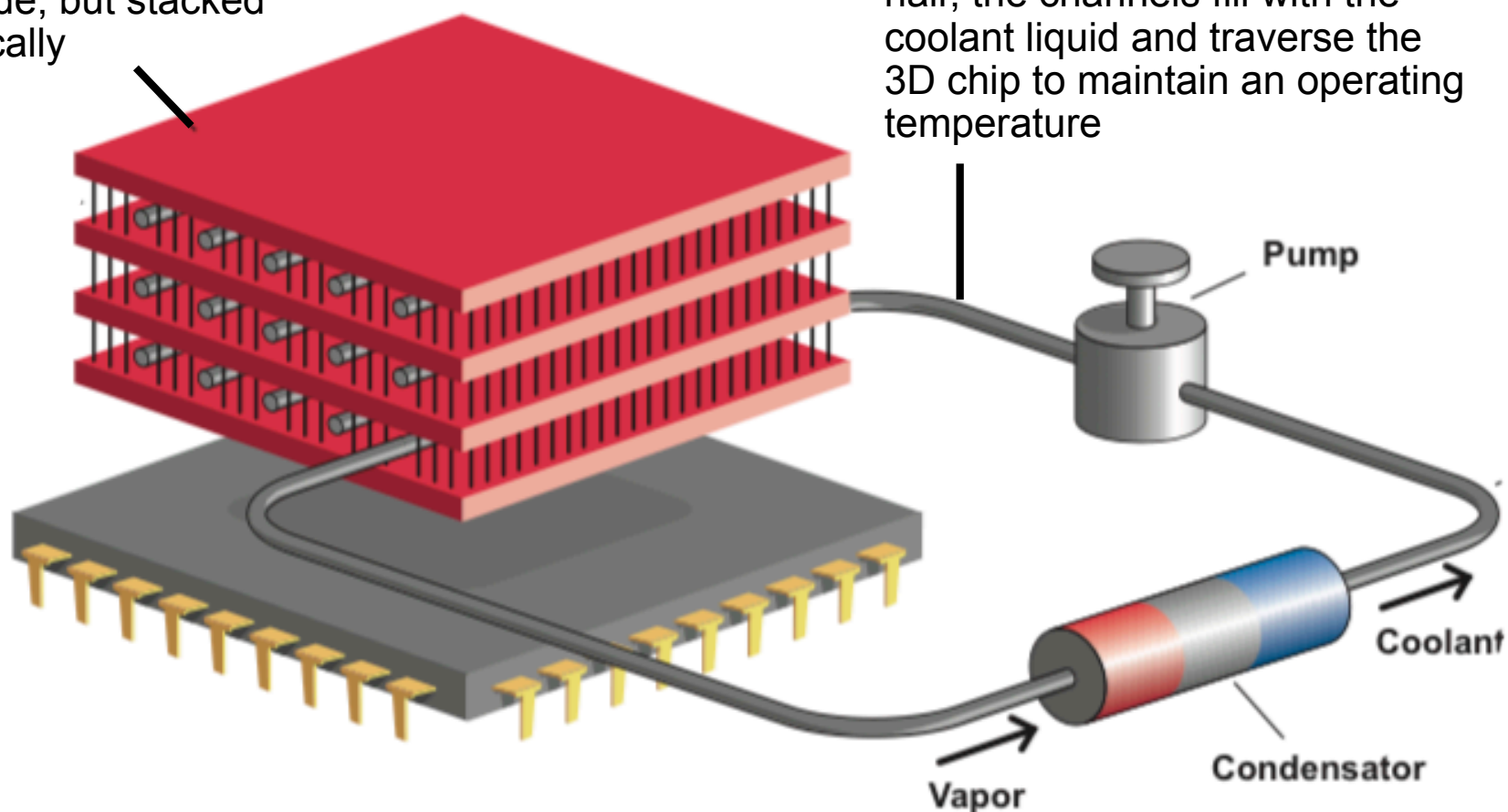


## What's next?

### Tomorrow's 3D Microchips: Less Energy, Less Heat

**Cores:** the cores are no longer side by side, but stacked vertically

**Channels:** as thin as a human hair, the channels fill with the coolant liquid and traverse the 3D chip to maintain an operating temperature



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## Summary

- Chip cooling technology needs to be combined with current computers in a more intelligent way
- Centralized computing more efficient and emission free
- Concept can scale to large data centers
- Aquasar Live:
  - Reduce emission by 85% through heat re-use on ETH campus
  - Save 40% of energy and through reuse reduce energy costs by more than 2x
  - ROI in 18 months
- Solution for Climate and Energy Grid Challenges

informatics Computational Biology  
Chemistry Mobile Web Vacuum Physics  
Processing Computer Architecture  
Machine Learning Fractals Blue Gene  
Cognitive Computing Artificial Intelligence  
Programming Languages & Software  
Operating Systems Storage Systems  
Nanotechnology Signal Processing  
Algorithms Interferometric Lithography

IBM Research