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## MIP 2 – project “Green Data Centers”

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# MIP 2 project “Green Data Centers”

- ❑ What is MIP?
- ❑ Why a feasibility study for Green Data Centers?
- ❑ The Project
  - ❑ Consortium partners
  - ❑ Work packages
  - ❑ Selected green and energy efficient technologies

# What is MIP?

- ❑ The Environmental & Energy Technology Innovation Platform (= MIP)
- ❑ Founded in 2005 by the Flemish Government
- ❑ Cooperation between the competence fields
  - ❑ Innovation
  - ❑ Environment
  - ❑ Energy
- ❑ Involvement of all relevant innovation actors from business, research institutes and government administrations
- ❑ MIP aims at closing material and process cycles according to the 'Cradle to cradle' philosophy

# What is MIP2?

- ❑ Continuation of MIP in 2009
- ❑ Main task is “greening” the economy
- ❑ Two funding programs
  - ❑ Program 1 : development and implementation of R&D-projects
    - ❑ focus on interdisciplinary cooperative research
    - ❑ demand-driven nature
  - ❑ Program 2 : set up of sustainable product and process cycles
    - ❑ focus on feasibility study
    - ❑ companies or clusters of companies
    - ❑ business models with respect of the use of sustainable materials and energy
- ❑ 13 projects approved
- ❑ MIP support of 3.7 M€

# Why a feasibility study for green data centers?

A data center today:

- ❑ 25 – 50 times more energy intensive compared to a conventional office building
- ❑ High, increasing electricity consumption
- ❑ High cooling demand
- ❑ Source of heat at low temperature



# Why a feasibility study for green data centers?

- ❑ About 42 Million servers installed globally (McKinsey Analysis)
- ❑ Data facility costs are growing 14% faster than overall IT spend (McKinsey Analysis)
- ❑ Increase of energy consumption per server amounts to 9% to keep up with performance demands (McKinsey Analysis)
- ❑ Data centers worldwide used 180 billion kilowatthours of electricity on power and cooling (2007) (McKinsey Analysis)
- ❑ True costs of ownership is 4-5 server costs (over 5-10 life span) (McKinsey Analysis)
- ❑ Energy consumption data center = 20 – 50 x energy consumption of office (Pacific Gas & Electricity Company, 2006)
- ❑ Energy consumption data centers USA = 1.5% of total energy consumption USA (Kooomey, 2007)

# Why a feasibility study for green data centers?

A data center tomorrow:

## □ Final Aim

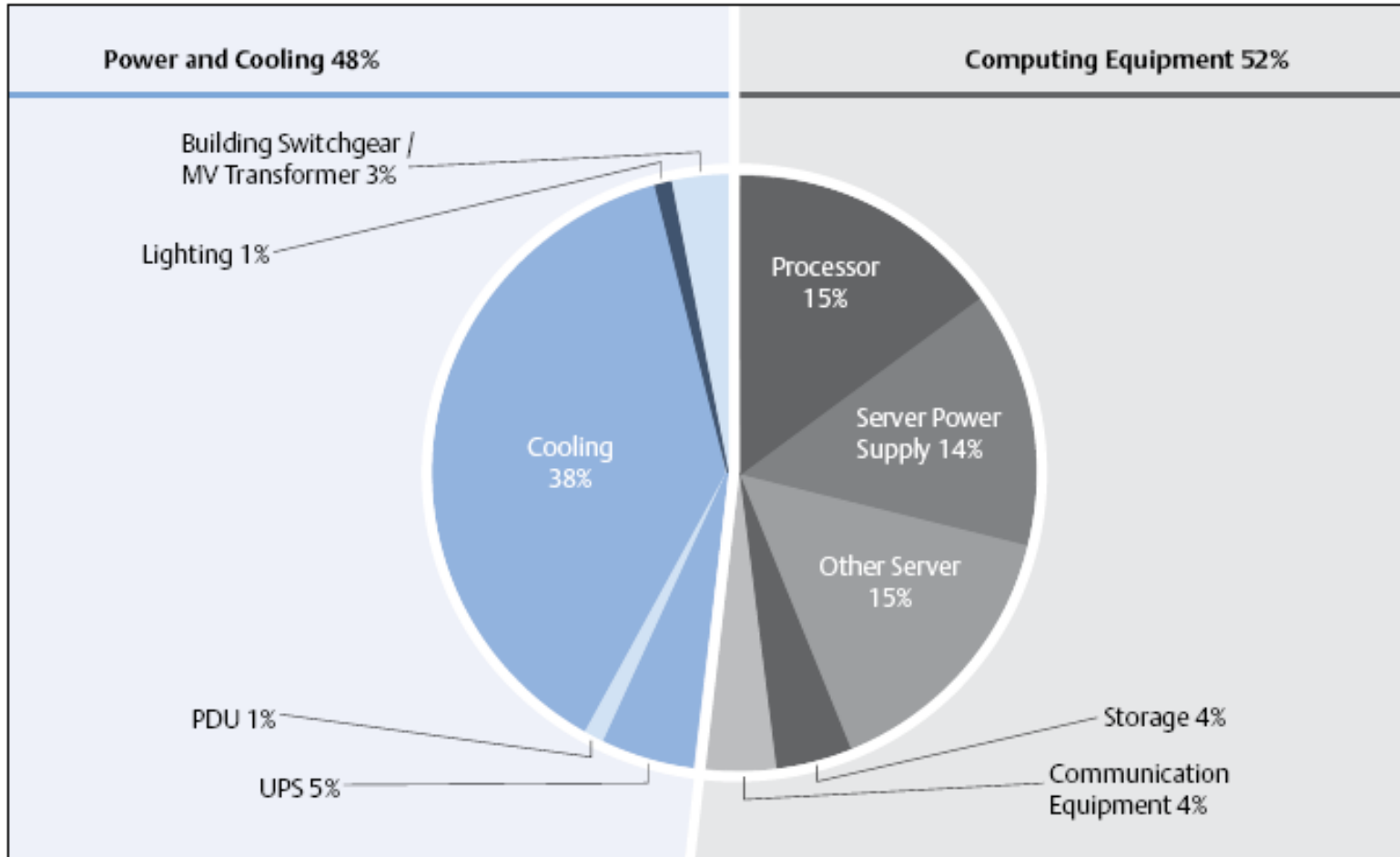


Energy neutral data centers with a low impact to the environment

## □ Aim of the feasibility study

Technical feasibility study and economic analysis of possible green energy technologies for data centers

# Why a feasibility study for green data centers?



\* Cooling load assuming chilled water based cooling system.

\* Based on a 5,000 ft<sup>2</sup> model data center

Source: Emerson Network Power, November 2007.

# The MIP2 project



## Consortium



## External partners



# The project – work packages

- WP1: Selection of data centers
- WP2: Technical feasibility study
- WP3 : Economic analysis
- WP4: Identification of possible barriers
- WP5: Possible recommendation to the involved actors
- WP6: Coordination and dissemination

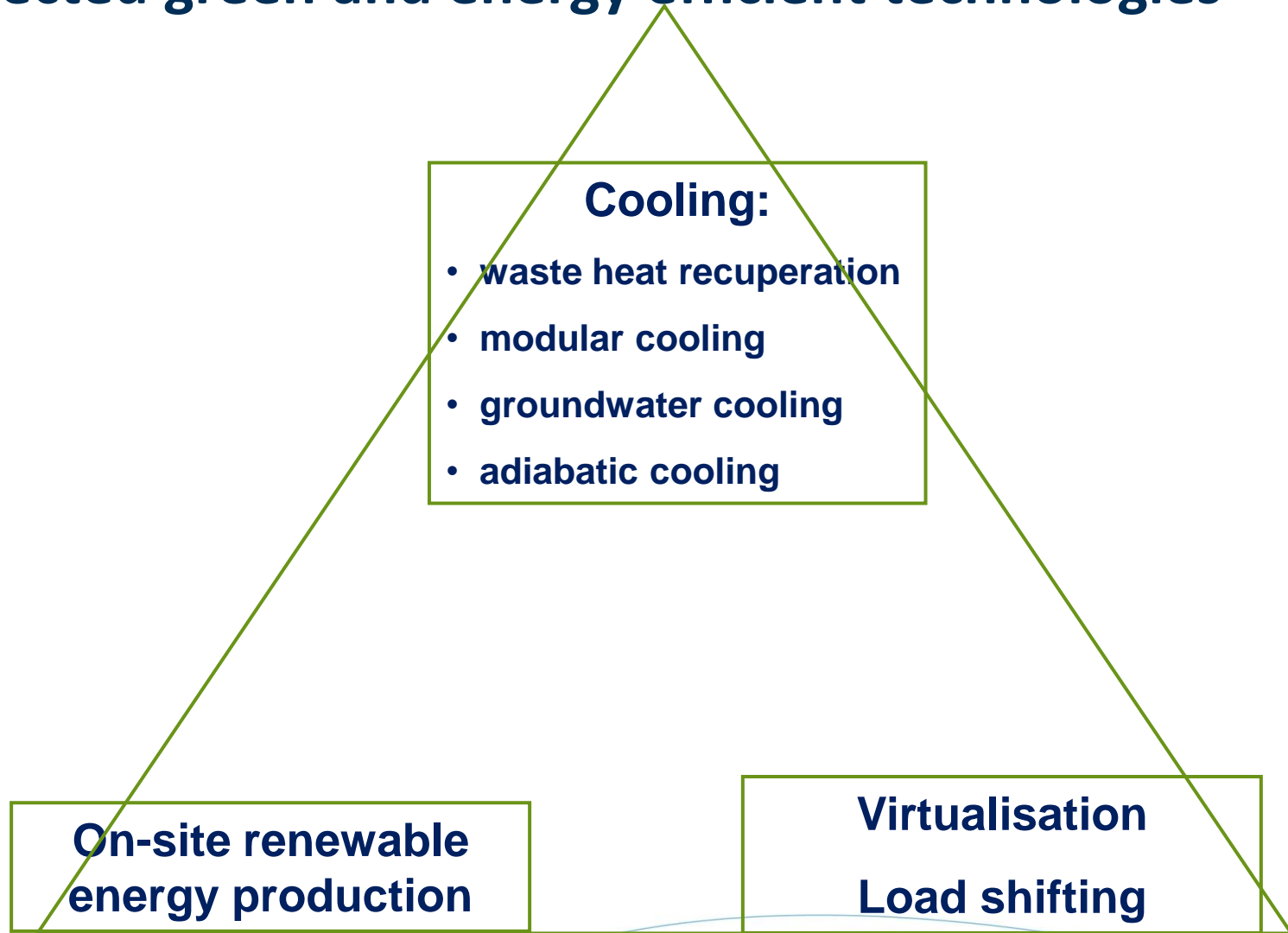
# The project – work packages

- ❑ WP1: Selection of data centers
  - ❑ Selection of 4 representative data centers of Telenet & a new built data center
  - ❑ Inventory of the installed equipment
  - ❑ Inventory of energy consumption (electricity and cooling)
- ❑ WP2: Technical feasibility study
  - ❑ Selection of realizable energy saving technologies
  - ❑ Trias Energetica
  - ❑ Technical feasibility study
  - ❑ Impact analyses on the environment

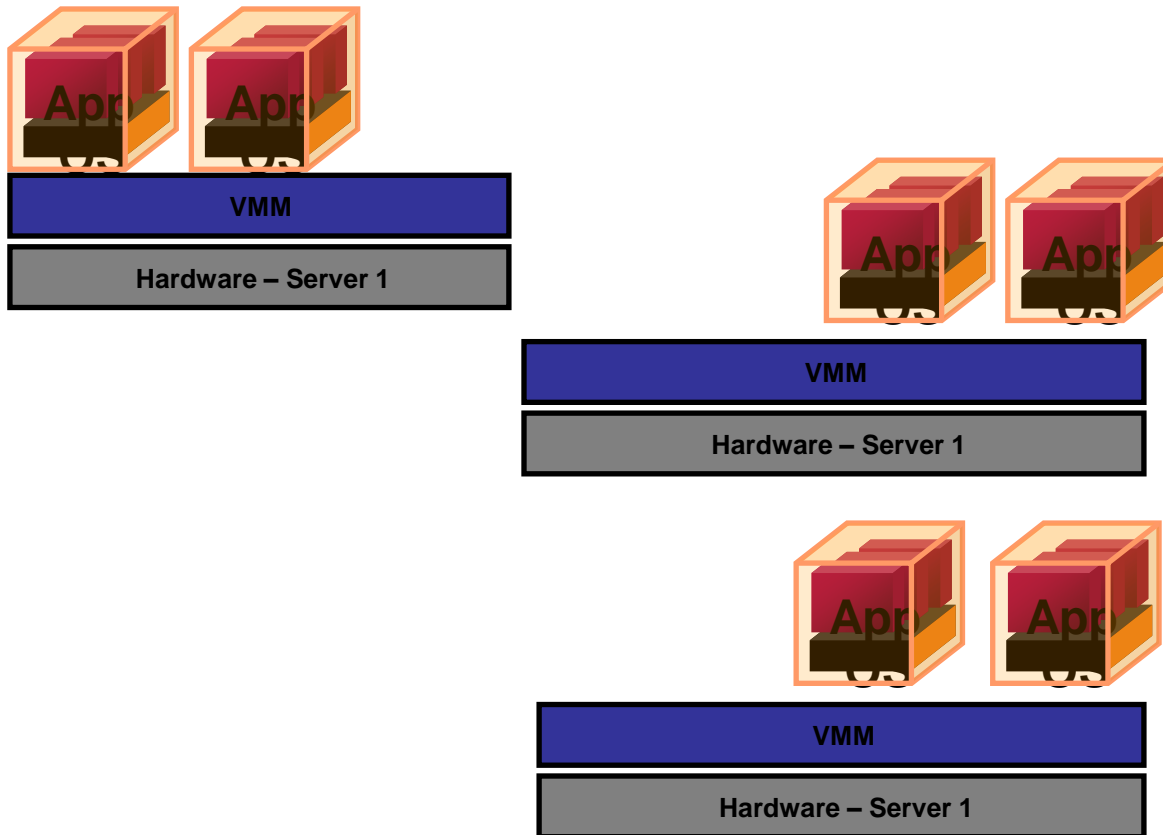
# The project – work packages

- WP3 : Economic analysis
  - determination of the costs & benefits
  - economic analyses: ROI, NPV, IRR
  - sensitivity analysis
- WP4: Identification of possible barriers
  - identification of technical and non-technical barriers
  - calculation of the financial gaps
- WP5: Possible recommendations to the involved actors

# Selected green and energy efficient technologies

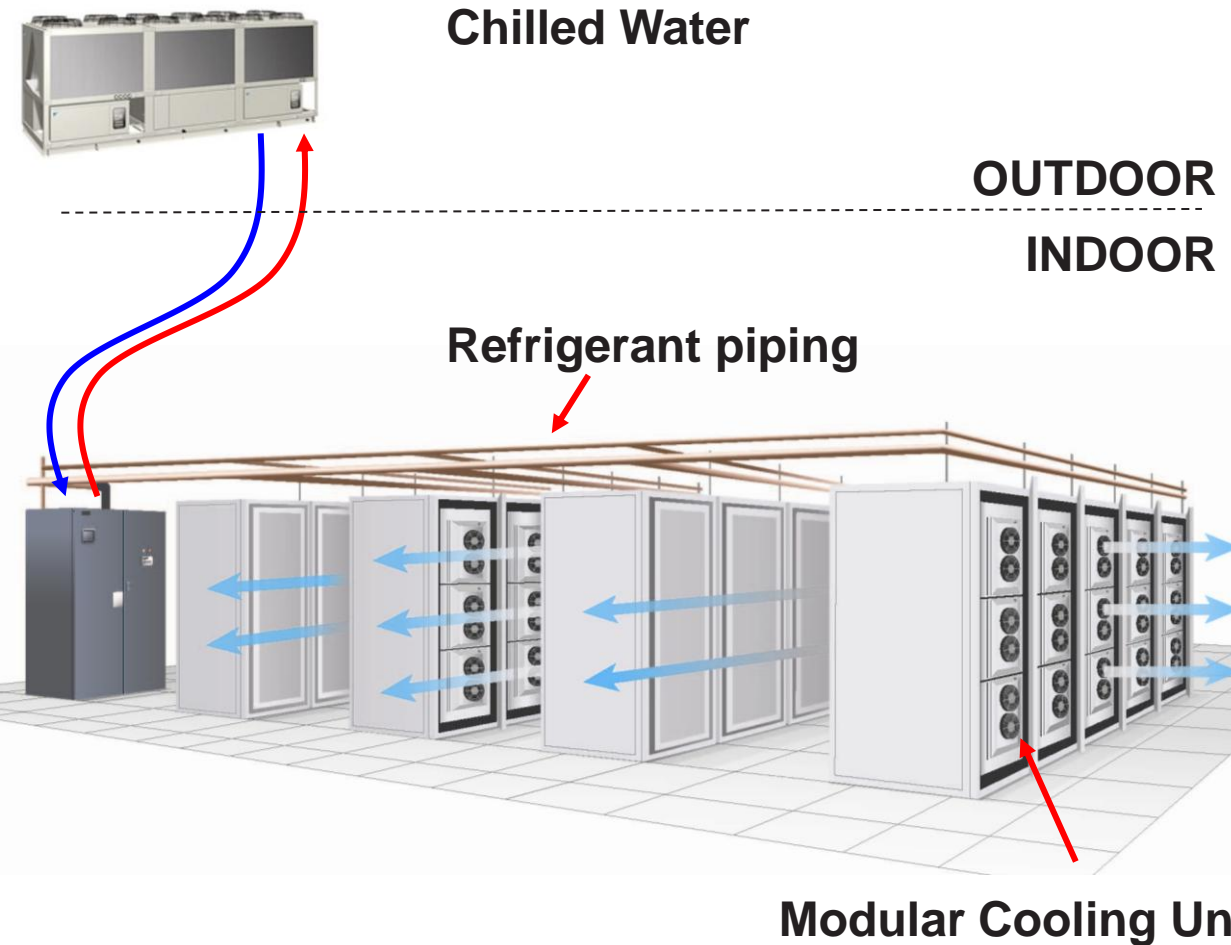


# Energy Savings inside the rack (Sizing Servers)



- ❑ Energy savings inside the rack
  - ❑ Leveraging Dynamic Power Management
  - ❑ Right form factor ( $\pm 10-15\%$ )
  - ❑ Right component choices ( $\pm 10-15\%$ )

# Modular cooling (Alcatel-Lucent)

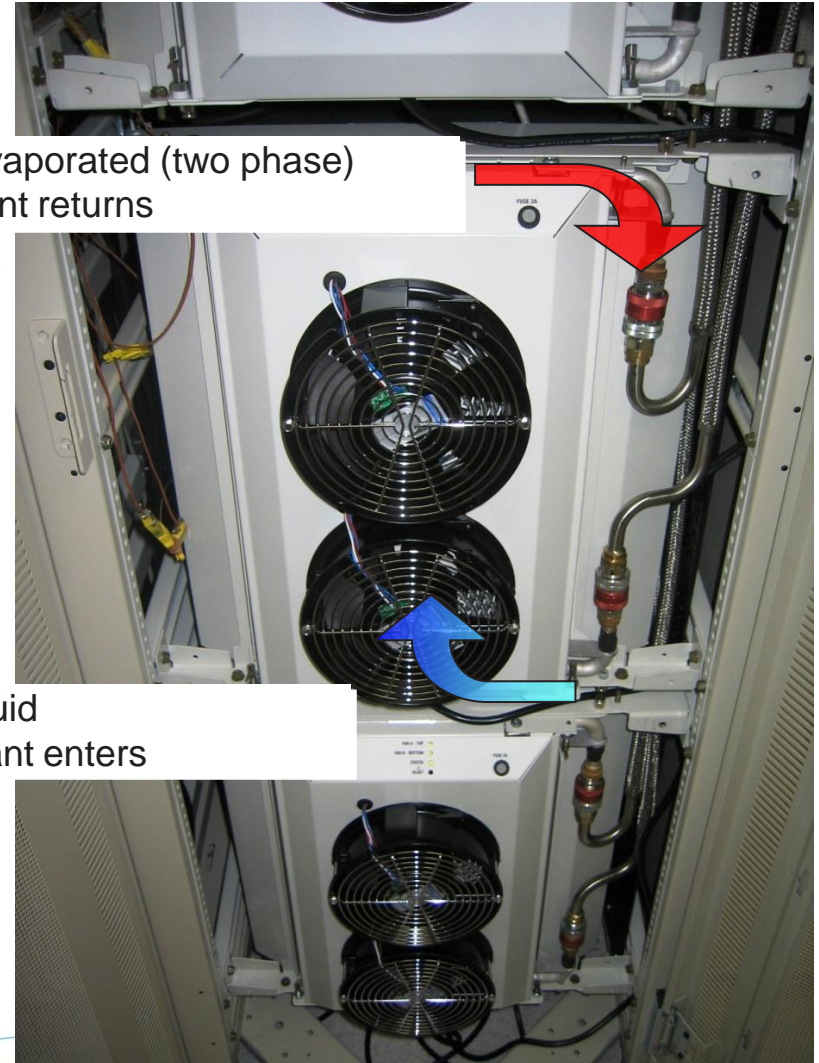


- ❑ cooling of the air directly on the server rack with the modular cooling unit
- ❑ Evaporation of a refrigerant in the modular cooling unit
- ❑ Transport of the heat by a refrigerant loop
- ❑ Condensation of the refrigerant by chilled water
- ❑ Cool air enters and leaves the equipment frames
- ❑ More stable temperature distribution in the room

# Modular cooling (Alcatel-Lucent)

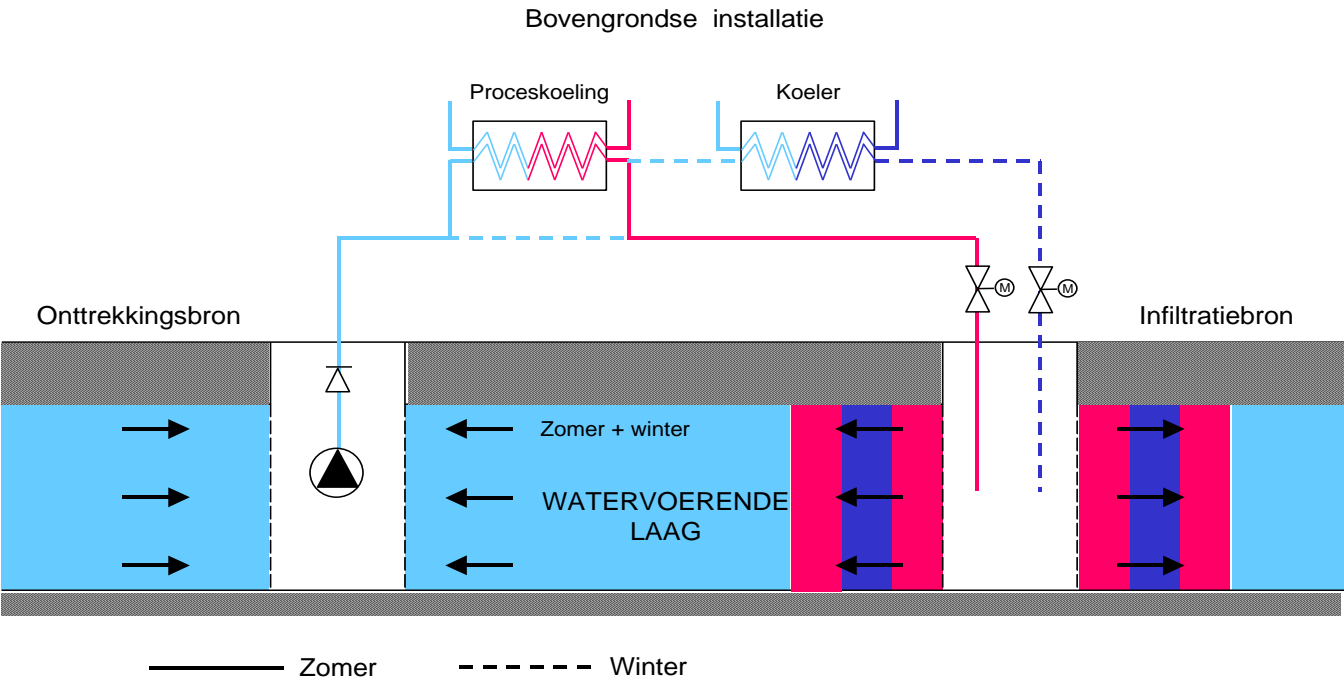


Partly evaporated (two phase) refrigerant returns



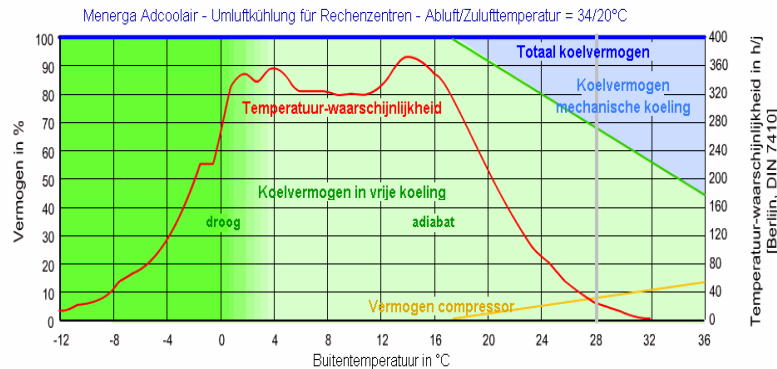
Cold liquid refrigerant enters

# Groundwater cooling (Terra Energy)

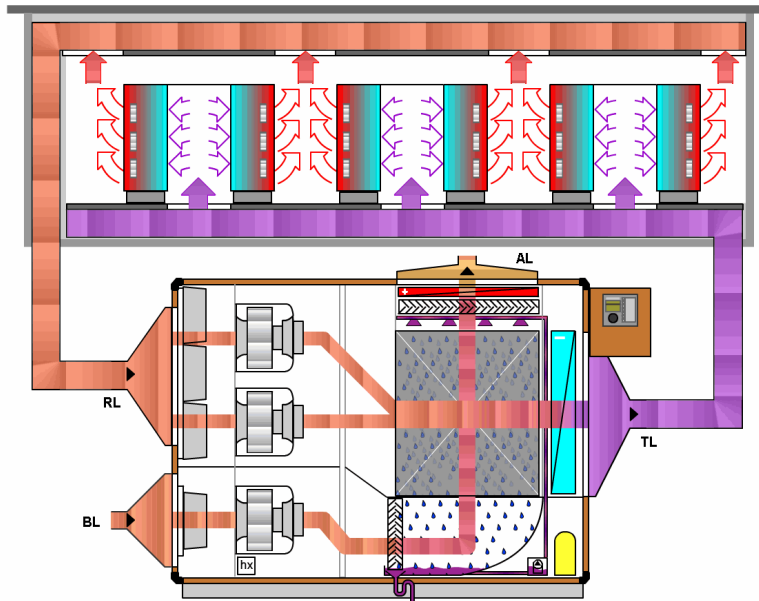


- ❑ Use of groundwater to cool the cooling water circuit of the data center
- ❑ Need for water bearing sand layers
- ❑ Injection well / infiltration well
- ❑ Ground water is used in summer months
- ❑ Ground water and cooling tower is used in winter months
- ❑ Balance between heat and cold stored

# Natural (adiabatic) cooling (Menerga)



- Use of ambient/natural cooling to cool the circulating air in the server room
- Dry cooling at low outside temperatures
- Evaporative cooling at medium outside temperatures
- Combination of evaporative cooling and mechanical cooling at higher outside temperatures
- Heat recuperation possible
- DDC control
- Modular system

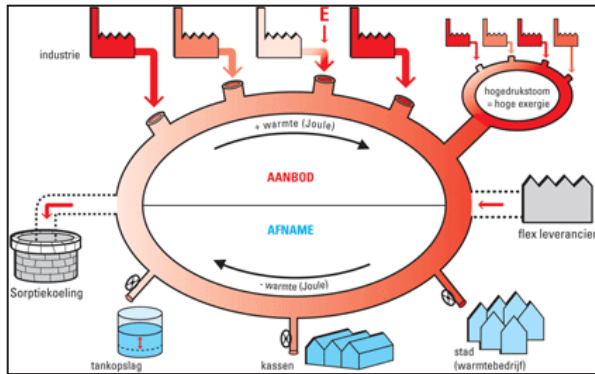


# Use of waste heat of the data center (VITO)



- ❑ Recuperation of low temperature heat of a data center
- ❑ Transportation to local low temperature heat consumers
- ❑ Possible users
  - ❑ Greenhouses
  - ❑ New /renovated office buildings
  - ❑ New/renovated houses/districts
  - ❑ Dry processes at low temperature
  - ❑ Preheating process water / hot tap water
- ❑ Feasibility of temperature lift with heat pumps

# Use of waste heat of the industry for cooling by absorption cooling (VITO)



- ❑ Valorisation of industrial waste heat (nearby industry)
- ❑ Transportation of the waste heat to the data center and other possible heat sinks
- ❑ Use of ad/ab sorption cooling to produce cooled water for the data center with local waste heat
- ❑ Integration of cooling towers to cool ad/ab sorption cooling



# On-site production of renewable energy (Alcatel – Lucent)



- ❑ Local production of renewable energy
- ❑ Possibilities of wind and solar
- ❑ Dimensioning
- ❑ Integration in the energy systems of the data center



# Conclusions

- ❑ Data centers today are energy intensive: high cooling demand, high electricity consumption (~180 billion kWh/year)
- ❑ Increase of energy consumption expected in the future
- ❑ Energy consumption can be reduced by introducing new energy saving technologies (ideal : energy neutral data center)
- ❑ Trias Energetica !
- ❑ MIP2 project
  - ❑ Technical feasibility study and economic analysis of selected technologies in specific cases of Telenet
  - ❑ Environmental impact
  - ❑ Identification of possible barriers
  - ❑ Possible recommendations to the involved actors

# More information

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