# WSTAR

Petri Välisuo
University of Vaasa

2026-02-28

# WSTAR

Wasa zero emission data centre

TB steering group meeting 26.08.2024

Vaasan yliopisto
UNIVERSITY OF VAASA
Åbo Akademi University
YRKESHÖGSKOLAN NOVIA
VAMK
VAASAN AMMATTIKORKEAKOULU
UNIVERSITY OF APPLIED SCIENCES

Funded by
the European Union
NextGenerationEU

SUOMEN AKATEMIA

# CONTENTS

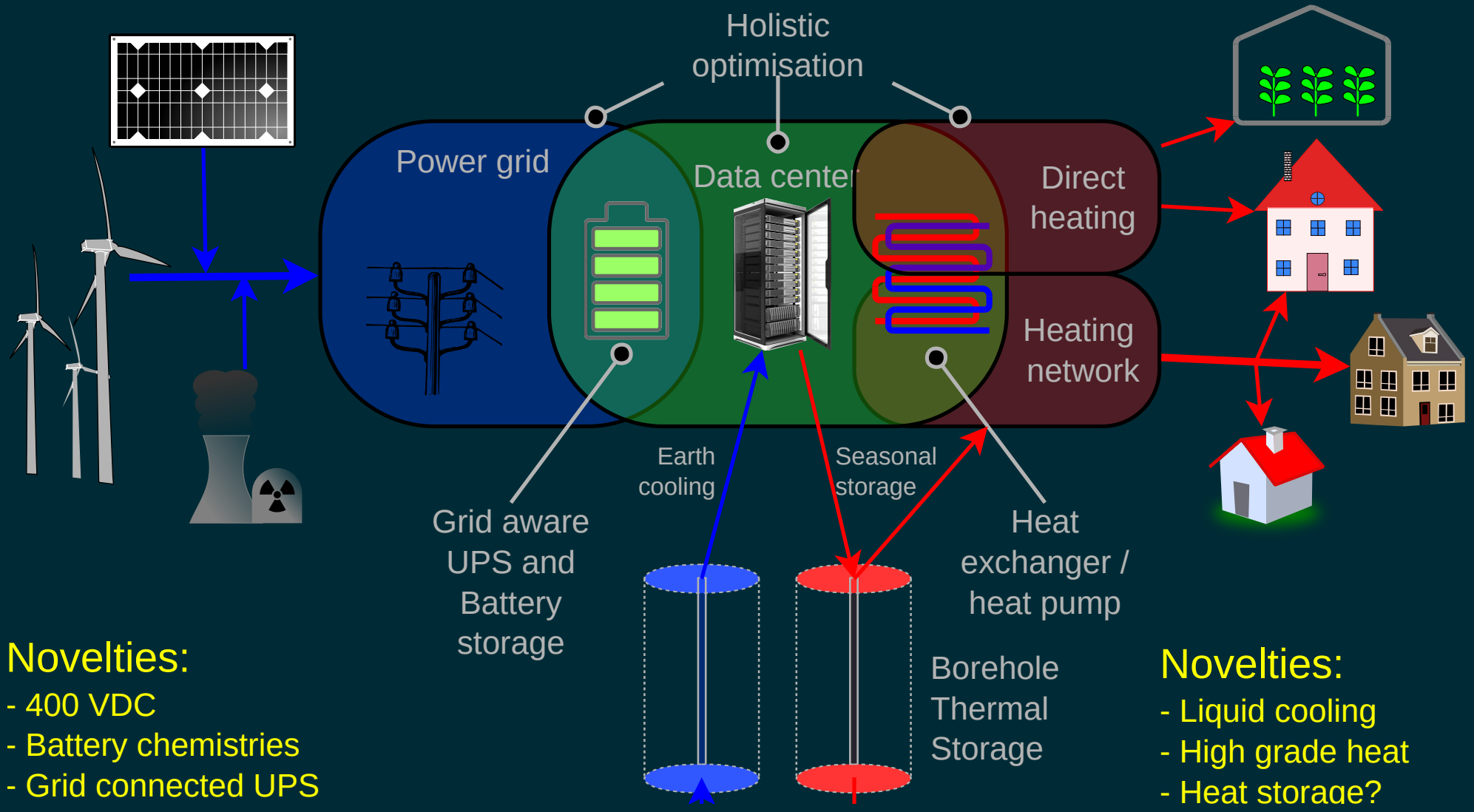
# WHAT IS WSTAR

# PROJECT DETAILS

- Academy Of Finland, FIRI project
- Timeline 1.1.2023 - 31.12.2025
- Total budget: 2 M€
- Partners:
  - University of Vaasa
  - Åbo Akademy
  - Novia University of Applied Sciences
  - Vaasa University of Applied Sciences (VAMK)

## Novelties:

- Sensoring, D-twin
- Sustainability reports
- ARM / FPGA / Chiplets?




## Novelties:

- 400 VDC
- Battery chemistries
- Grid connected UPS

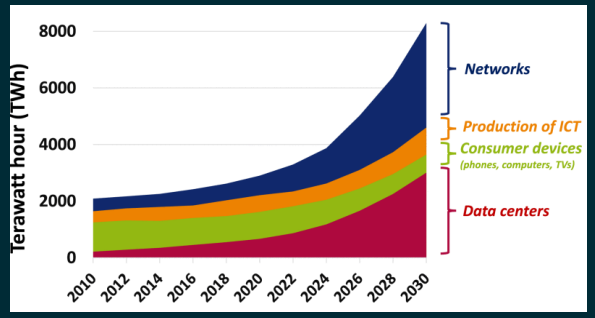
## Novelties:

- Liquid cooling
- High grade heat
- Heat storage?

# WHY WSTAR?

# WHY DATA CENTERS ARE IMPORTANT

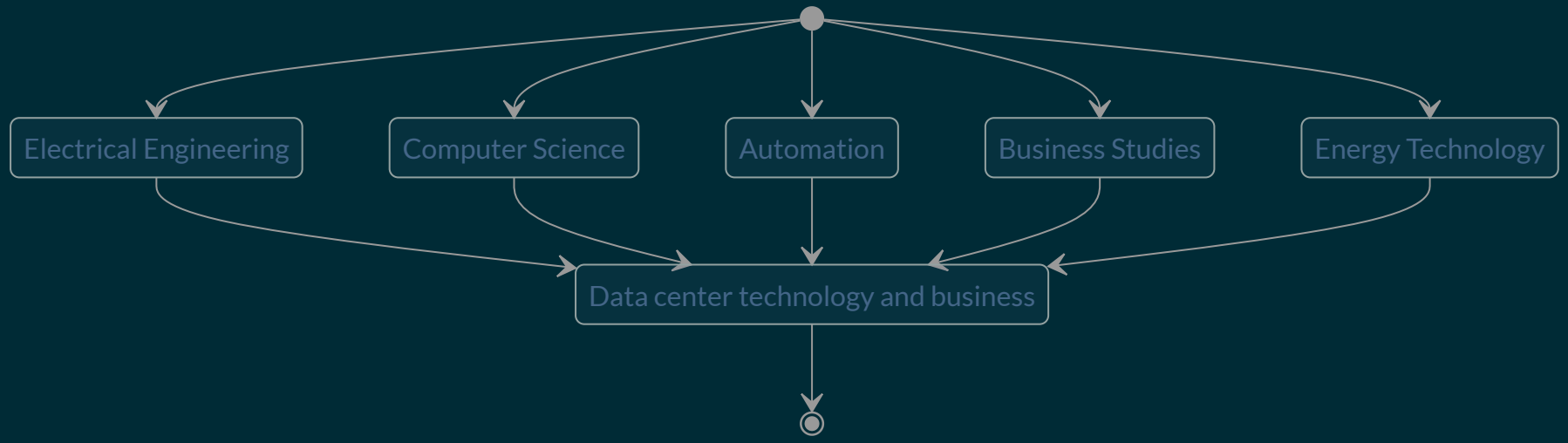
- Heart of the Internet
- Nordic countries are ideal location
- No previous research infrastructure in Finland
- Connects heat to power
- Data centres consume 3 TWh of electricity, less than 1% of heat utilised
- New EU Energy Efficiency Directive (EED)
- New sustainability metrics needed
- EU Commission: data centers will consume 3.2% of the power of the EU member countries in 2030



# RESEARCH

- BF, 400 VDC power supply: Measurements, current breakers, DC/DC converters, power control, switches, UPS
- Interreg Aurora, Energy efficiency: Vaasa-Kajaani-Luleå-Norway, Liquid cooling and heat reuse
- Compilers and programming languages: How to run AI code efficiently in the data center?
- Automation: Edge data center in a loop, with real time 5G communication
- Electrical engineering: virtual protection relays (see vPAC alliance vision

# EDUCATION




- Data center courses provides a specialization topic to students from different programs
- The courses will be organized together with the data center industry and Finnish Data Center Association
- Local collaboration between UVA, ÅA, Vamk, Novia and Vamia
- Wide area collaboration with XAMK, Savonia, Luleå and Norway

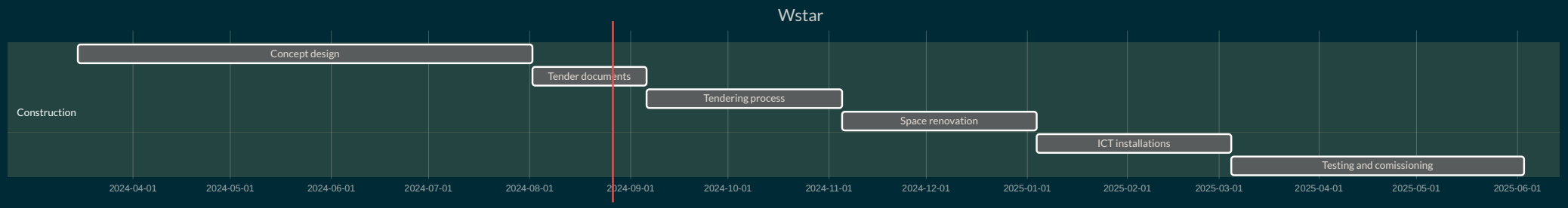
# SOCIETAL IMPACT

AI, technology and energy saving

- Find ways how to use AI and how to do it in sustainable way
- Develop energy technology in Vaasa region
- Provide more skilled personnell for data center operations
- Attrac more data center business to Finland
- Lower energy prices due to increased flexibility in power grid and added heat supply

# CURRENT STATE AND NEXT STEPS

# NEXT STEPS




- Concept design is done
- Negotiate the tendering process with KPMG
- Sign the co-ownership contract
- Tendering of work and equipment
- Space renovation and installation
- Negotiate with the industry of collaboration
- Internal and external communication

# BUDGET

| Cost item | Cost |
|---|---|
| Services: Project management | 80 000 |
| Construction | 230 000 |
| - Room construction | 20 000 |
| - Mechanical | 100 000 |
| - Fire suppresion | 4 000 |
| - Electrical cabling | 45 000 |
| - Electrical distribution and rectifier | 65 000 |
| - Building automation | 20 000 |
| UPS and batteries | 45 000 |
| IT HW and servers | 365 000 |
| **Total** | **622 000** |

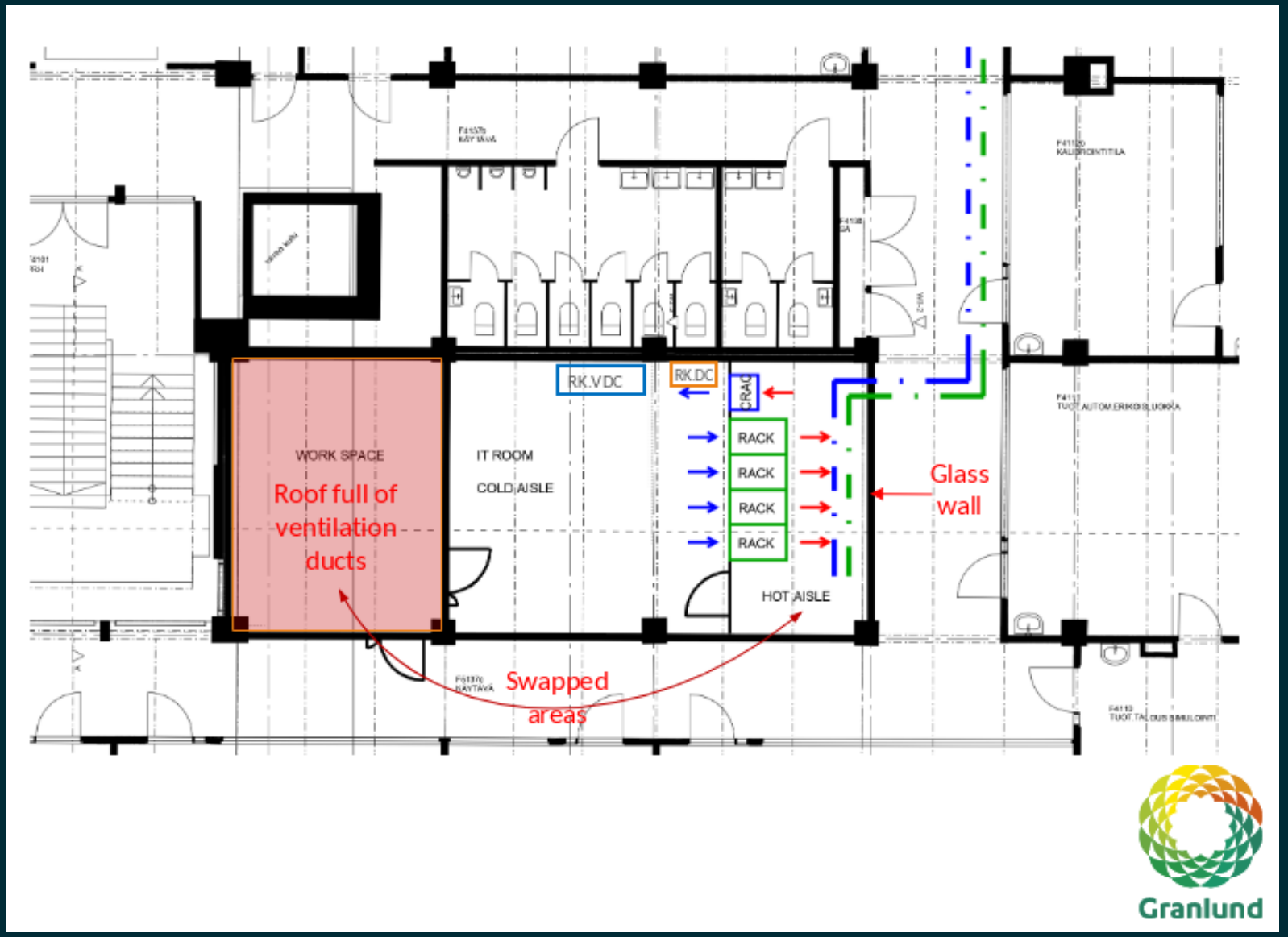
# IT HW (EXAMPLE CONFIGURATION)

New components

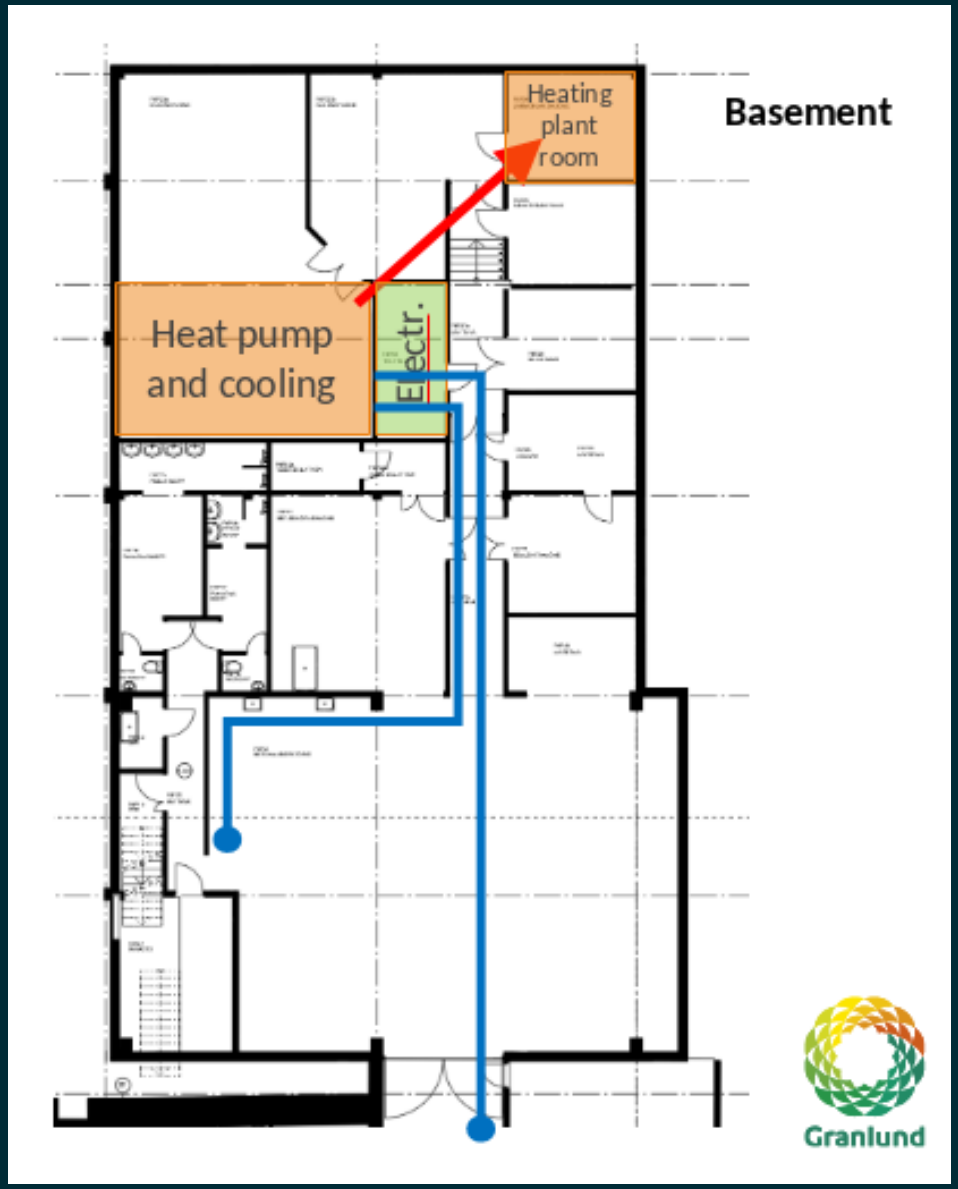
- 7x ThinkSystem SR665 V3, 2U, AMD EPYC 9254 200W + Nvidia L40s (900W)
- 7x ThinkSystem SR650 V3, 2U, Intel Xeon Gold 6418H 185W + Nvidia L4 (665W)
- Row cooler (liquid)
- UPS
- 2 racks (1200 x 800 x 2000 mm) (d,w,h)
- Network swithes and cabling

Some second hand servers for experimental cooling systems and education purposes.

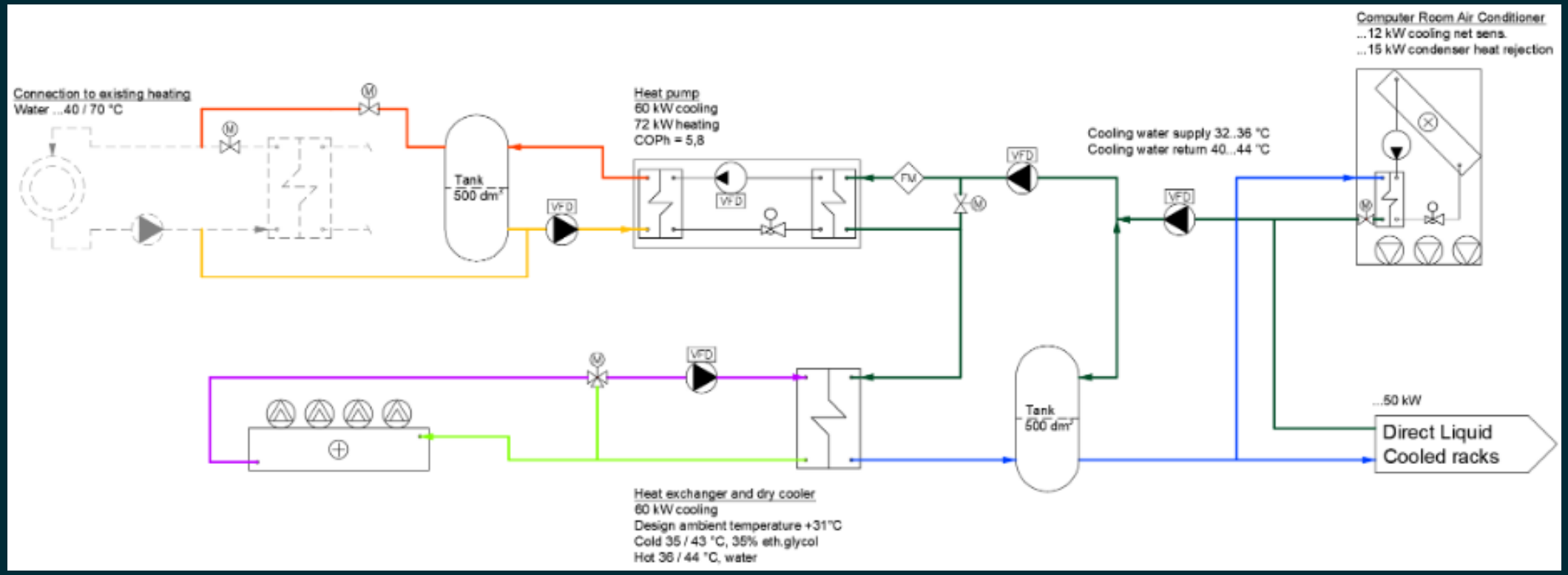
# LAYOUT (NEEDS SOME UPDATES)



# SPACE IN BASEMENT

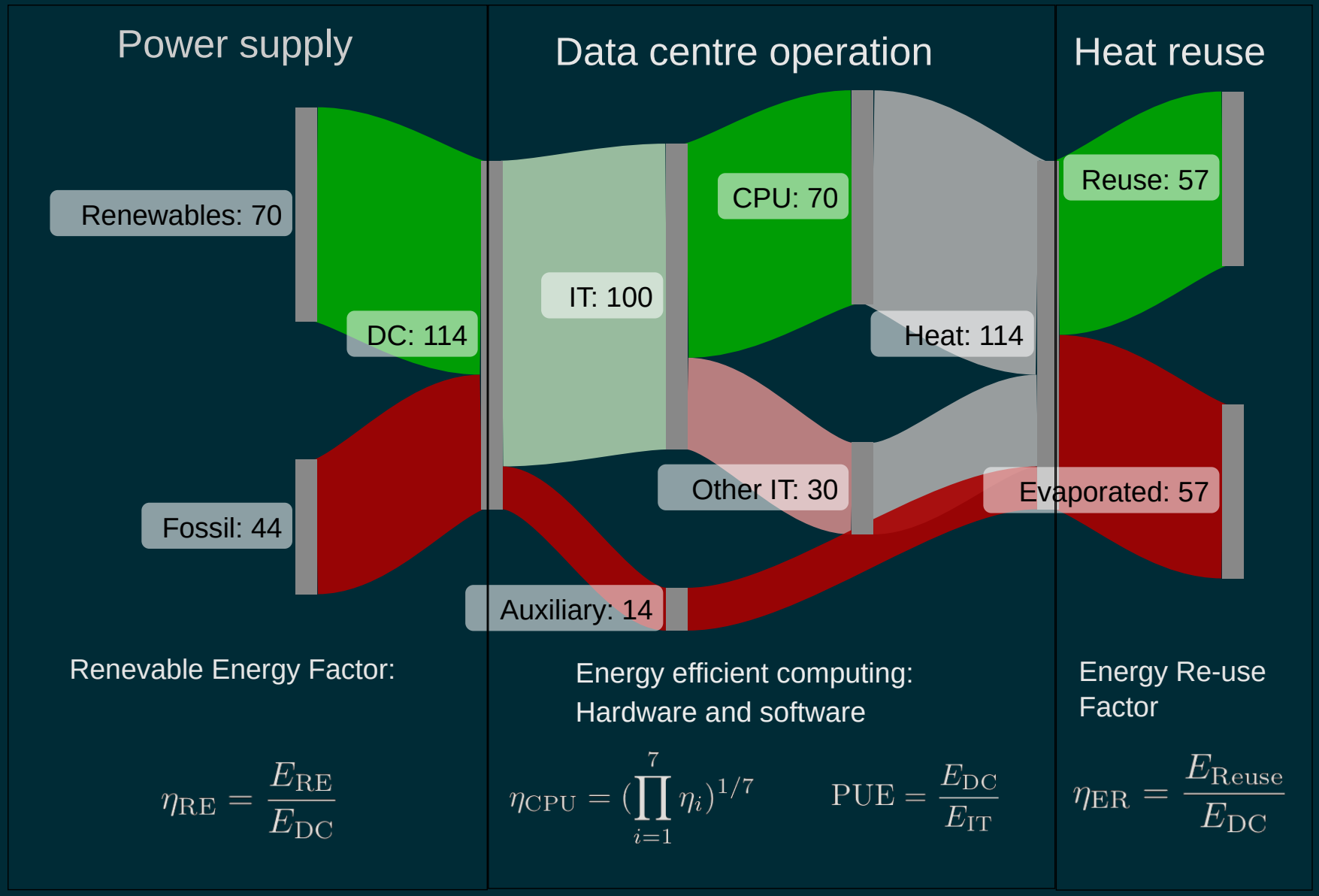


# COOLING AND HEAT REUSE



# OPEN RESEACH INFRASTRUCTURE

# NEW SUSTAINABILITY METRICS?




Renevable Energy Factor:

$$\eta_{\mathrm{RE}} = \frac{E_{\mathrm{RE}}}{E_{\mathrm{DC}}}$$

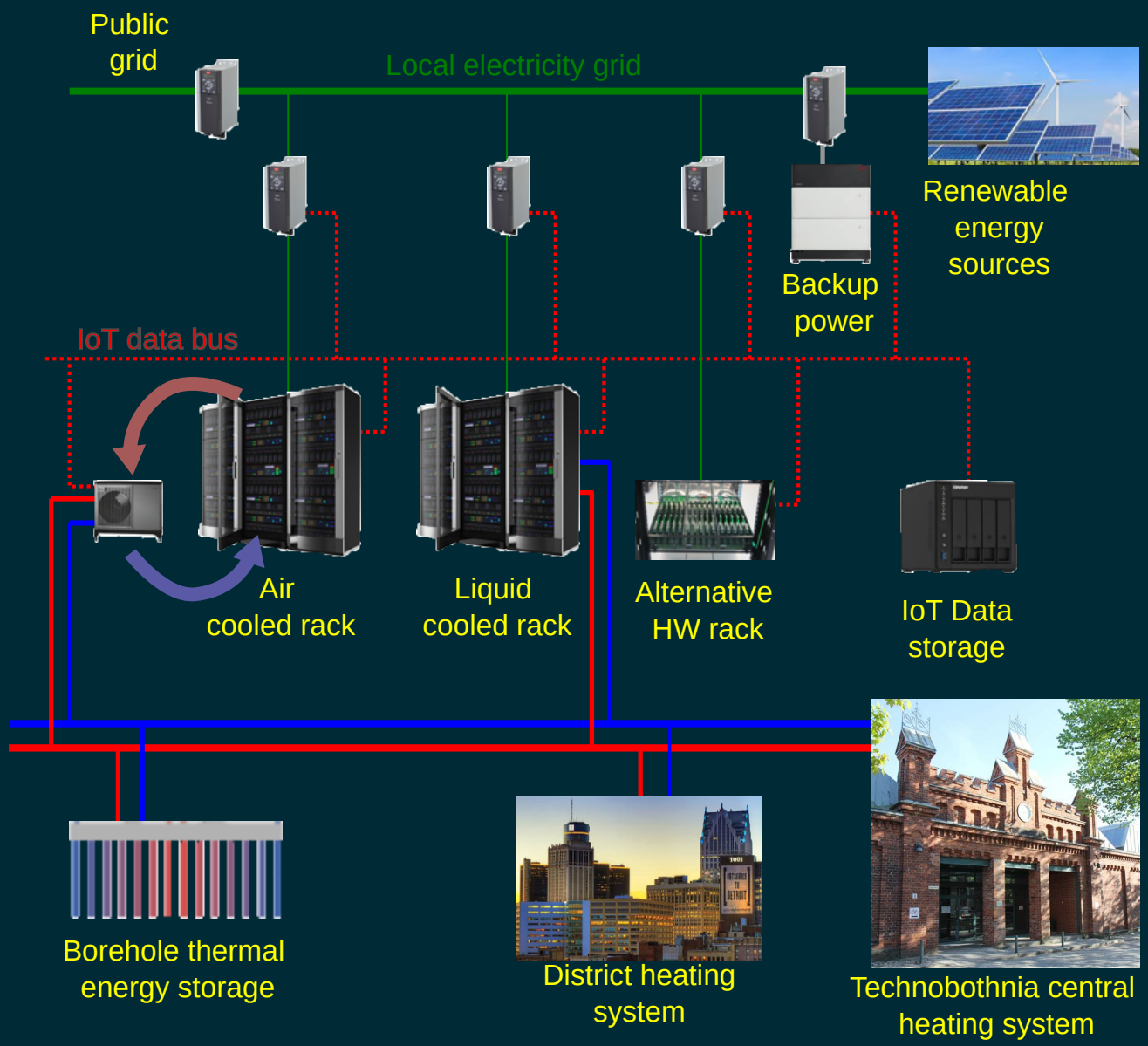
Energy efficient computing:
Hardware and software

$$\eta_{\mathrm{CPU}} = \left(\prod_{i=1}^{7} \eta_i\right)^{1/7} \qquad \mathrm{PUE} = \frac{E_{\mathrm{DC}}}{E_{\mathrm{IT}}}$$

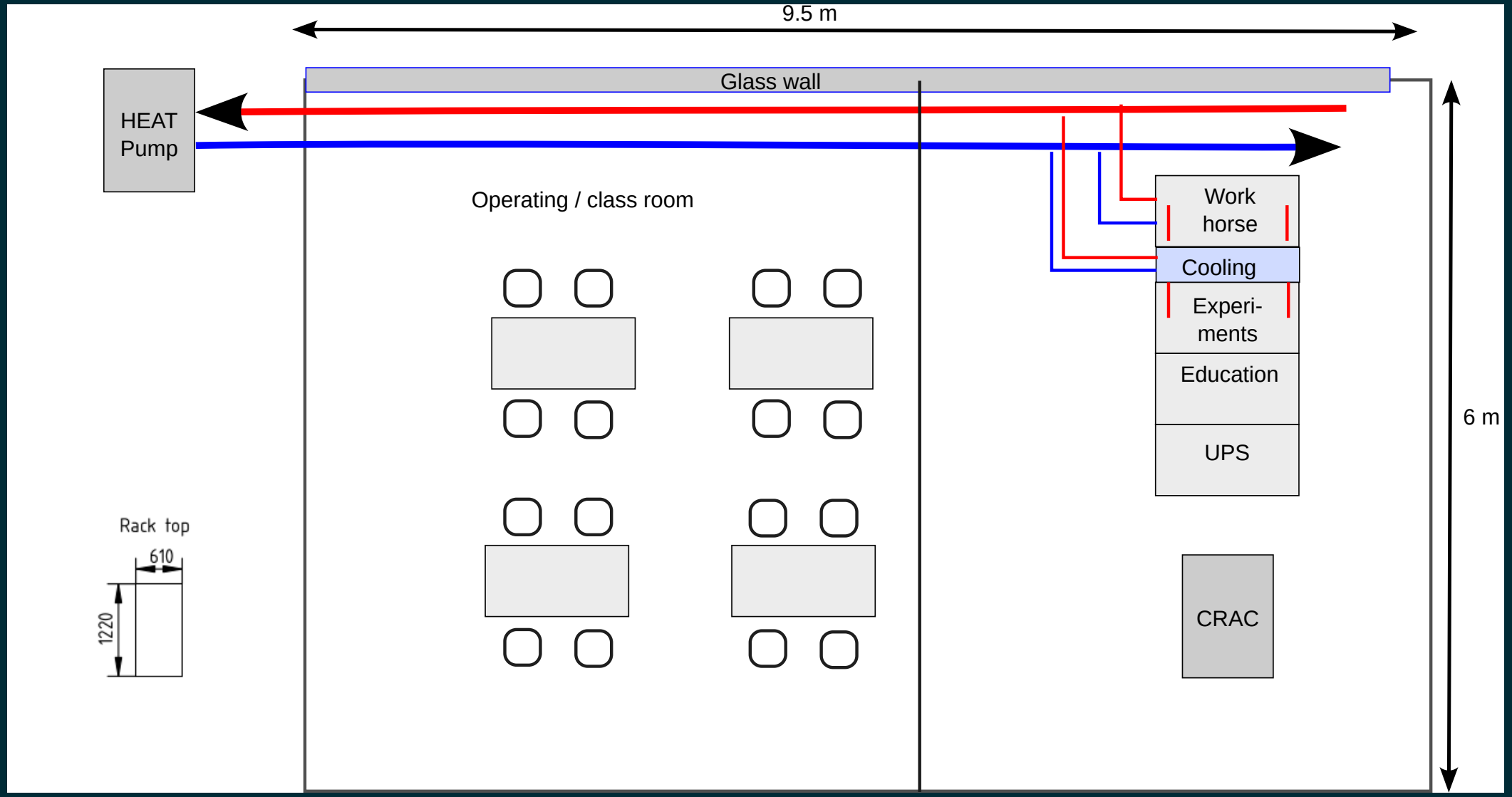
Energy Re-use Factor

$$\eta_{\mathrm{ER}} = \frac{E_{\mathrm{Reuse}}}{E_{\mathrm{DC}}}$$

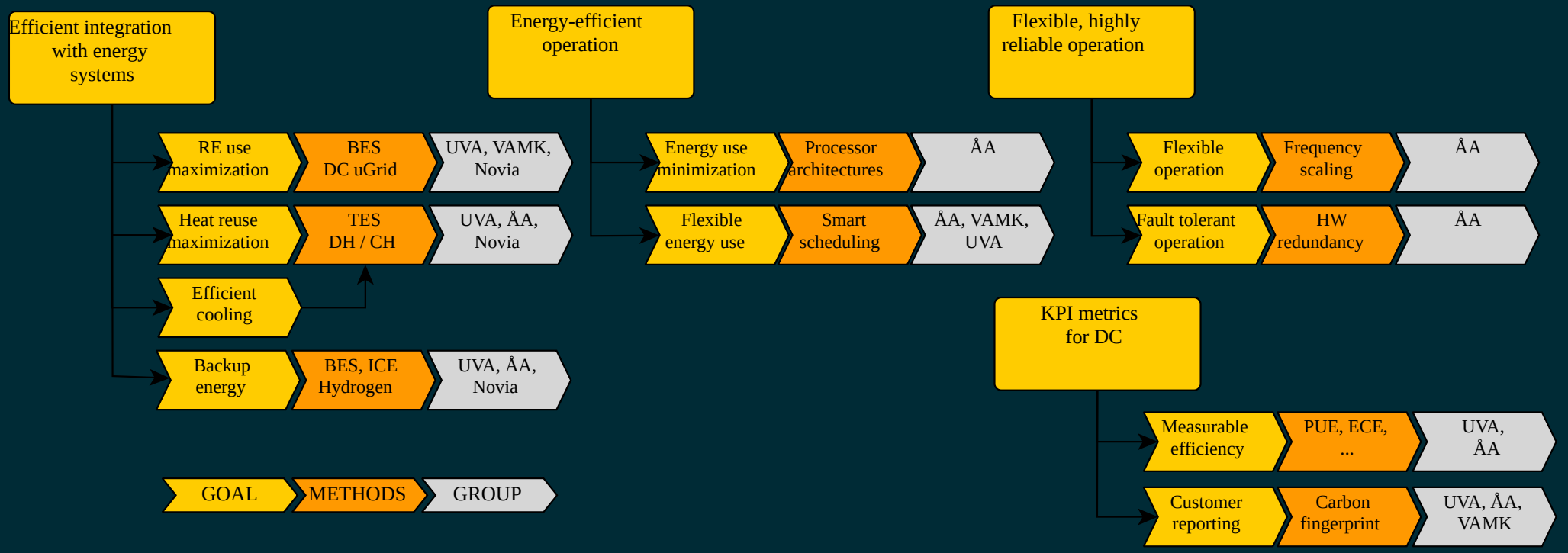
# OVERALL STRUCTURE OF WSTAR



# WSTAR COMPONENTS



# RESEARCH QUESTIONS




Research questions

# COLLABORATORS

| | Interests | Processing architectures | Flexible energy markets | Electricity availability considered scheduling | Battery storage | Efficient power supply solution | Thermal storage | Geo-cooling | Waste heat utilization | Fuel-based backup power | Data Center |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Research partners | University of Vaasa | | ✸ | ✸ | ✸ | ✸ | ✸ | ✸ | ✸ | ✸ | ✸ |
| | Åbo Akademy | ✸ | ✸ | ✸ | ✸ | | | | ✸ | ✸ | ✸ |
| | Novia | | | ✸ | ✸ | ✸ | | | ✸ | ✸ | ✸ |
| | Vamk | | | ✸ | ✸ | ✸ | | | | | ✸ |
| Other collaborators | Eindhoven | | | | | | | ✸ | ✸ | | ✸ |
| | HULL | | | | | | | ✸ | ✸ | | ✸ |
| | RICE ICE | ✸ | ✸ | ✸ | ✸ | ✸ | ✸ | ✸ | ✸ | | ✸ |
| | DCA | ✸ | | ✸ | ✸ | ✸ | | | ✸ | ✸ | ✸ |
| Industrial collaborators | ABB | | ✸ | | ✸ | ✸ | | | | | ✸ |
| | Wartsila | | ✸ | | ✸ | | | | ✸ | ✸ | |
| | Wapice | ✸ | ✸ | ✸ | | | | | | | |
| | Granlund | ✸ | ✸ | ✸ | ✸ | | | | | | ✸ |
| | Hitachi | | ✸ | ✸ | ✸ | ✸ | ✸ | | | | |
| | Danfoss drives | | | | ✸ | ✸ | | | | | |
| | Vaasan Sähkö | | ✸ | | ✸ | | ✸ | ✸ | ✸ | ✸ | |
| | Tieto EVRY | ✸ | | ✸ | ✸ | ✸ | | | | | ✸ |

Research questions