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Optimizing Waste Heat Utilization from Edge Data Centers

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Goals

- To seek optimal design concept for the integration of edge data centers in buildings
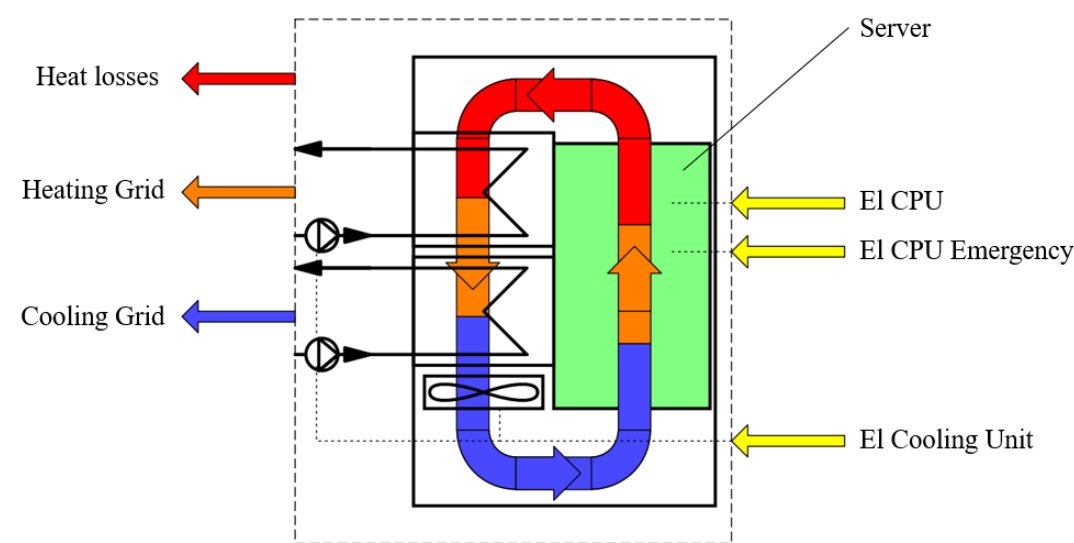- Understand the effect of different sizes and boundary conditions

Fig 1: Heat recovery unit of the air-cooled edge data center

Problem

- Increasing electricity prices
- Mismatch between IT workload and building heating energy demand
- Multi-vector interdependencies
- Quality and usability of the waste heat
- Different cooling options: air-cooling, liquid-cooling, oil-immersed

Introduction

- Small-scale decentralized edge data centers up to 250 kW
- low latency / high scalability/reliability / flexible operation
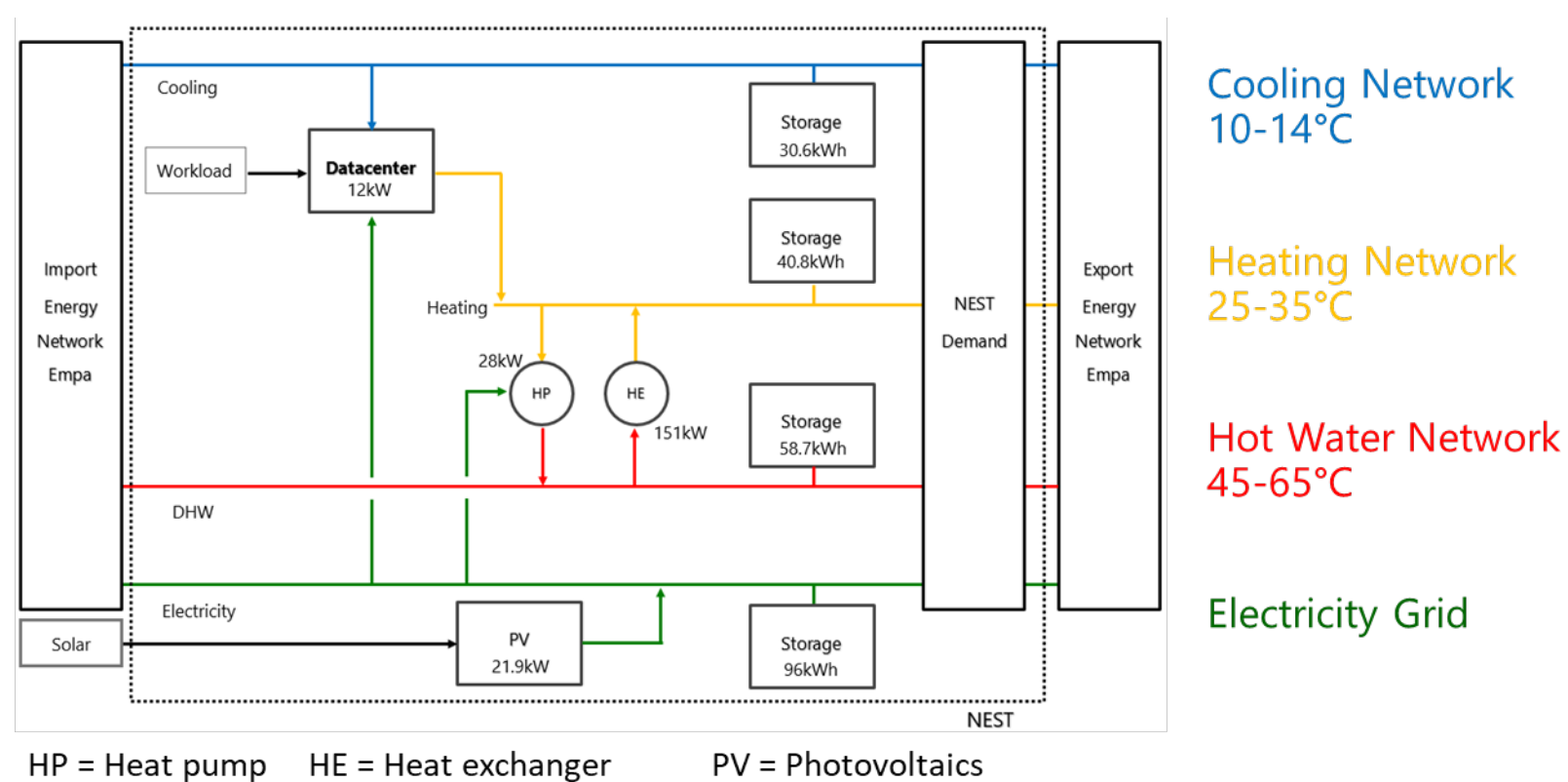- Provide heat where and when it's needed

HP = Heat pump   HE = Heat exchanger   PV = Photovoltaics

Fig 2: Integration of Eco-Qube data center @NEST (base)

Method

- Must-run and flexible (virtual storage model) IT workload
- Heat recovery unit captures usable heat expending electricity and cooling energy (air-cooled)
- Multi-objective optimization (Cost/CO2) using Ehub tool
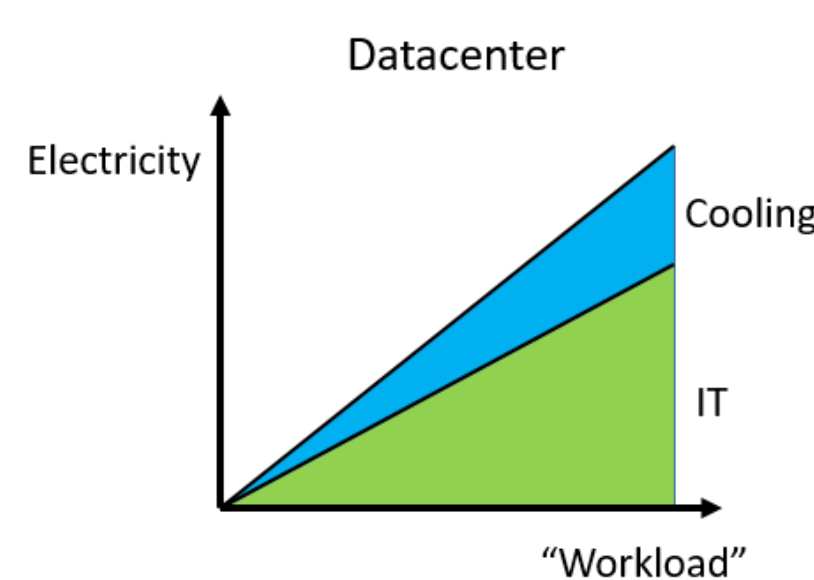- KPIs: Annualized costs/emissions, Annual saved energy/emissions, self-consumed heat/electricity fractions
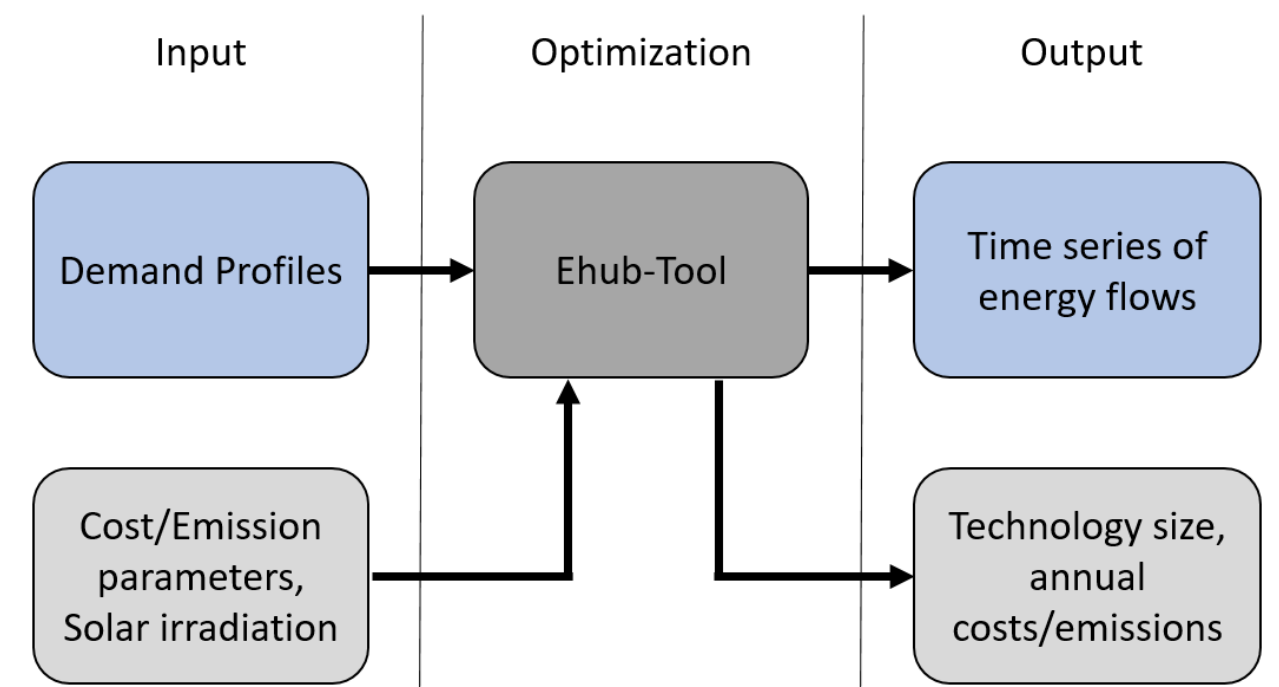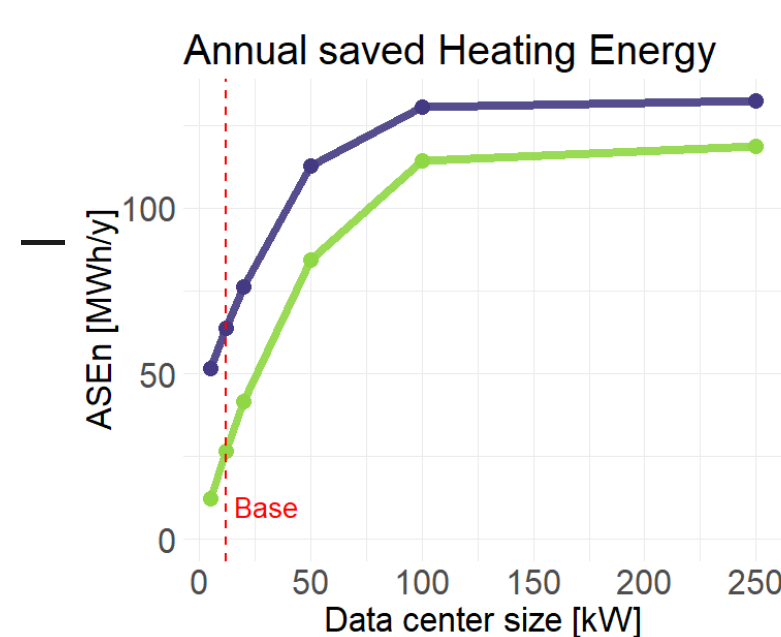

Fig 3: IT workload vs. electricity consumption

Fig 4: Multi-objective optimization of edge data center using Ehub tool

Results

- Higher heating demand → more heat reused → more cost efficient but saturates above building demand - Electricity major influence on costs

Conclusions

- Optimal sizing depends on building demand and available conversion and storage techs
- Benefits from waste heat recovery alone not viable but improves the business case
- Future: more efficient liquid cooling options

Core partners

UNIVERSITÉ DE GENÈVE   HSLU Hochschule Luzern   OST Ostschweizer Fachhochschule

ETH zürich   zhaw School of Engineering   Empa Materials Science and Technology

Associate partners

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