

# ENERGY CRISIS

## IMPACT ON UNIVERSITIES AND RESEARCH DATA CENTRES

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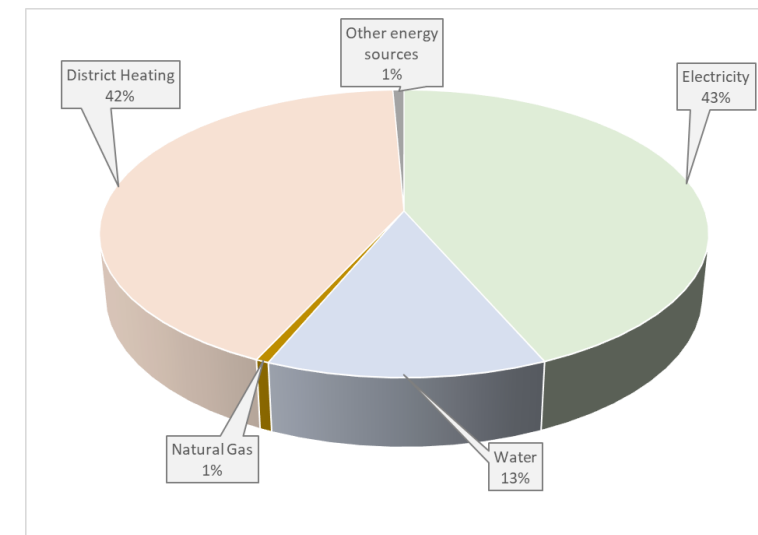


UWB Campus

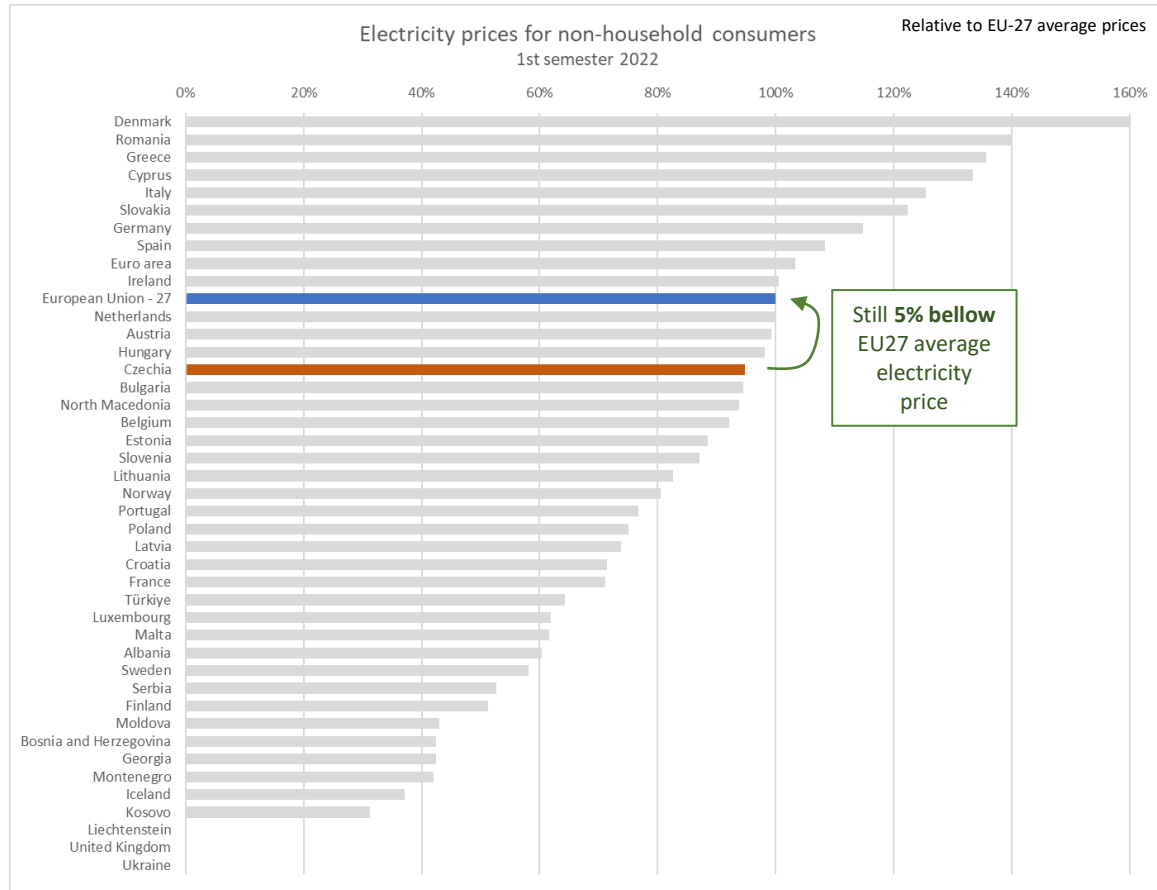
## UWB campus

- four faculties, two research centers, an administrative building, university restaurant and a library.
- connected to
  - the local distribution network
  - the thermal network stemming from the district combined heat and power source .

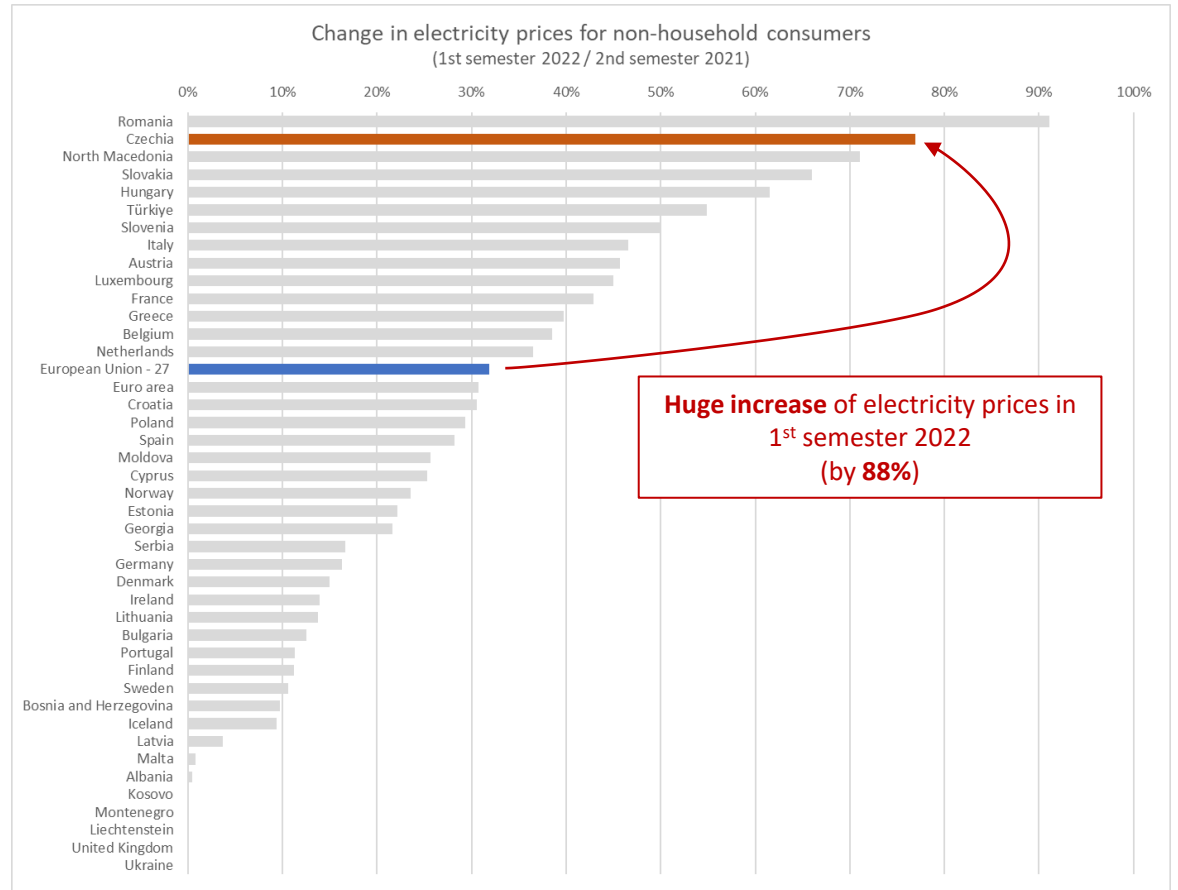
	2018	2019	2020	2021	Costs [%]
Electricity [MWh]	10650	10435	9407	10154	43,5%
Water [m3]	108948	103804	70750	77763	12,8%
Natural Gas [m3]	74461	70843	59141	61364	0,6%
District Heating [GJ]	77928	70607	66424	77580	42,4%
Other energy sources	Structure of energy costs 2021				0,7%



Source: VÝROČNÍ ZPRÁVA O HOSPODAŘENÍ ZÁPADOČESKÉ UNIVERZITY V PLZNI ZA ROK 2021



High electricity prices, but still bellow EU-27 average



Extreme and rapid change in the electricity prices → significant problem for mid-term planning of budgets

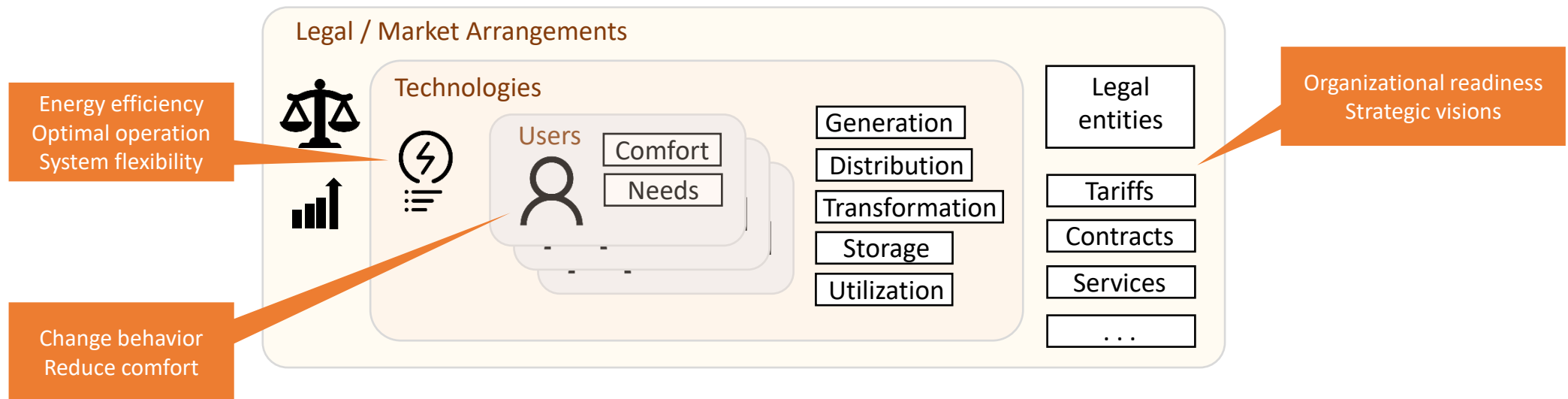
Energy Savings



Cost Savings

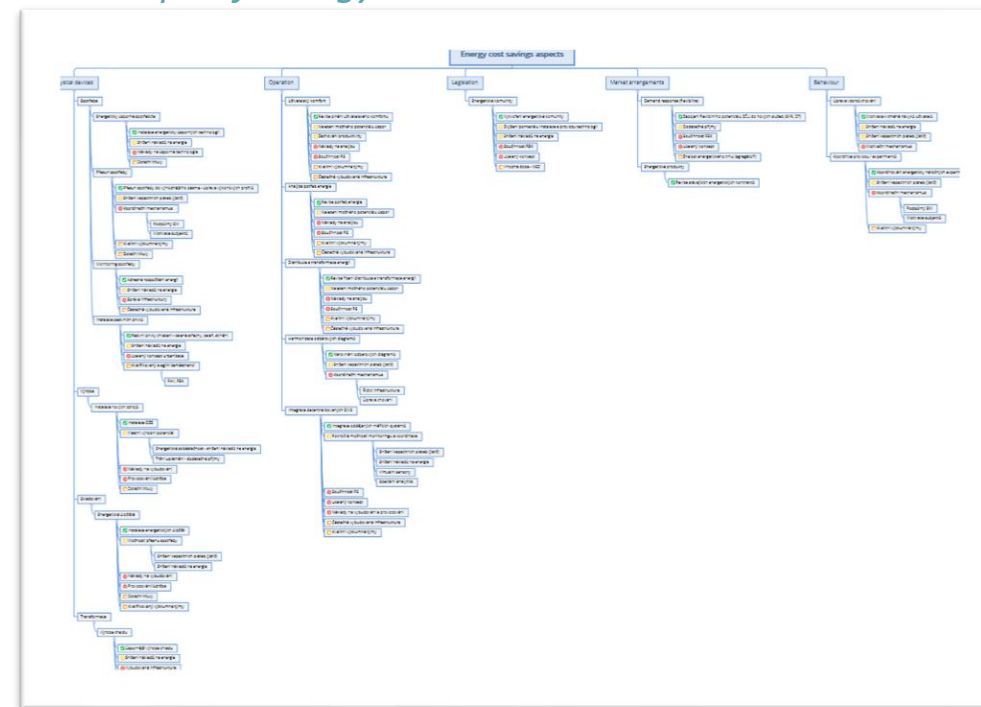
- reduction of **energy volume** necessary for generation, transformation, distribution, storage and utilization of energy vectors satisfying user (comfort) requirements

- reduction of **costs** necessary for generation, transformation, distribution, storage and utilization of energy vectors satisfying user (comfort) requirements



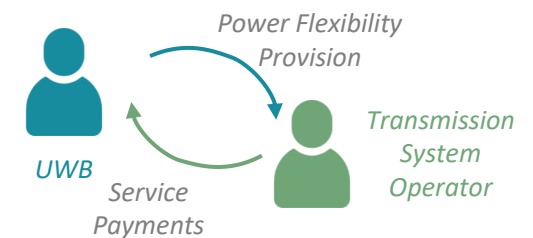
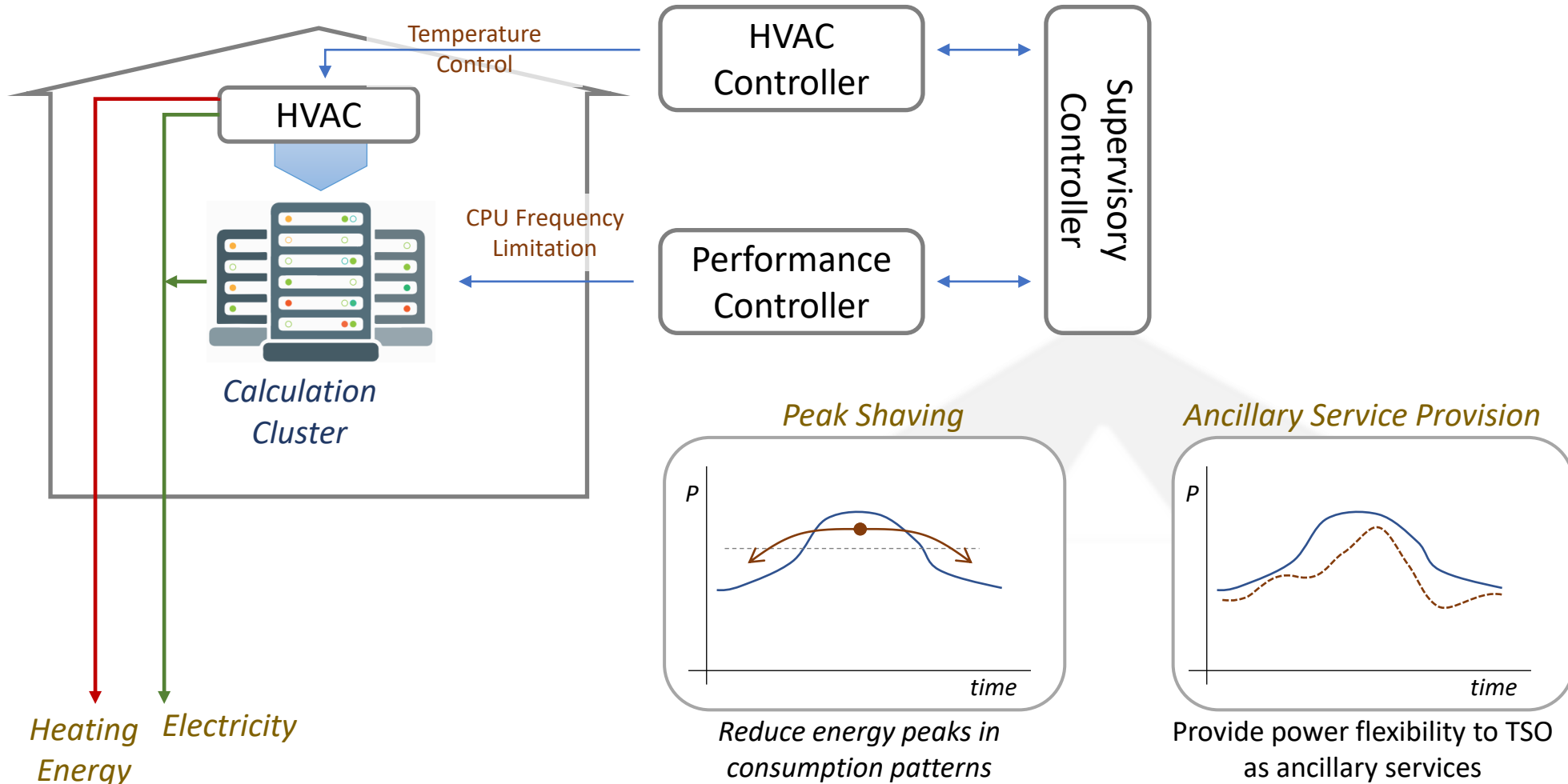
- **Physical devices** – properties of installed equipment
  - Energy efficiency
  - Flexible operation
  - Reasonable procurement and deployment
  
- **Operation** – efficient operation of physical devices
  - User comfort/needs satisfaction
  - Efficiency maximization of technical systems
  
- **Legislation** – suitable legal and regulatory form
  - Compliance with legislation and regulation
  - Novel legal forms such as energy communities
  
- **Market arrangements** – maximization of cost savings
  - Optimization of contracts/tariffs
  - Providing energy services, ...
  
- **User behavior** – modification of user behavioral patterns
  - Change of behavior
  - Reduction of user comfort/requirements ...

*Landscape of energy measures areas*



## UWB actions

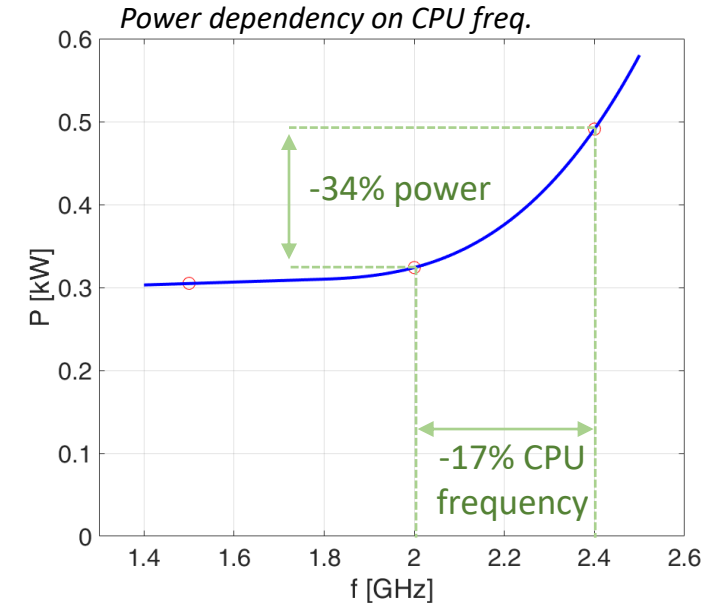
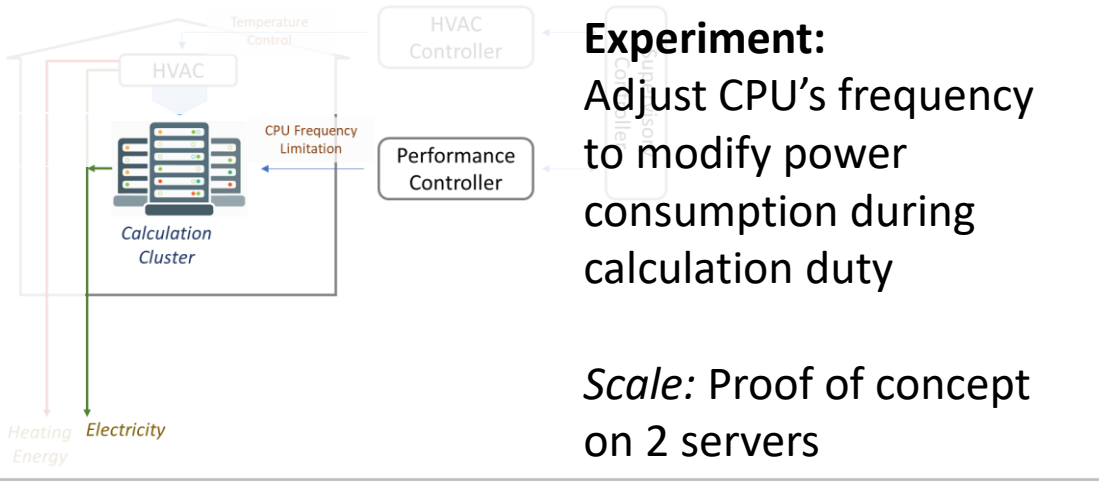
- interdisciplinary expert team established
- development of strategic energy concept
- comprehensive assessment of savings measures



Use case	Power peak shaving	Ancillary services provision
<b>Meaning</b>	Reduce energy peaks in consumption patterns	Provide power flexibility to ancillary services maintaining power grid stability (FCR, aFRR)
<i>Physical devices</i>	Computation cluster HVAC system	
<i>Operation</i>	Cluster's computation performance modification HVAC cooling system optimization	
<i>Legislation</i>	Complaint with the current legislation and regulatory aspects	Complaint with upcoming legislation and regulatory aspects
<i>Market arrangement</i>	Current market arrangement suitable	Relationship between stakeholders needs to be clarified (aggregator, infrastructure operator, building operator)
<i>User behavior</i>	Lower computation performance during services provision (longer computation time)	

## Key functionality (*computation cluster*):

Ability to modify consumed power based on CPU's frequency limitation



### Results

17% CPU frequency reduction leads to:

- 34% power consumption
- 10% temperature

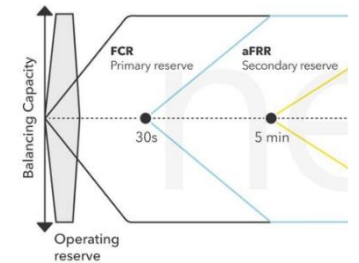
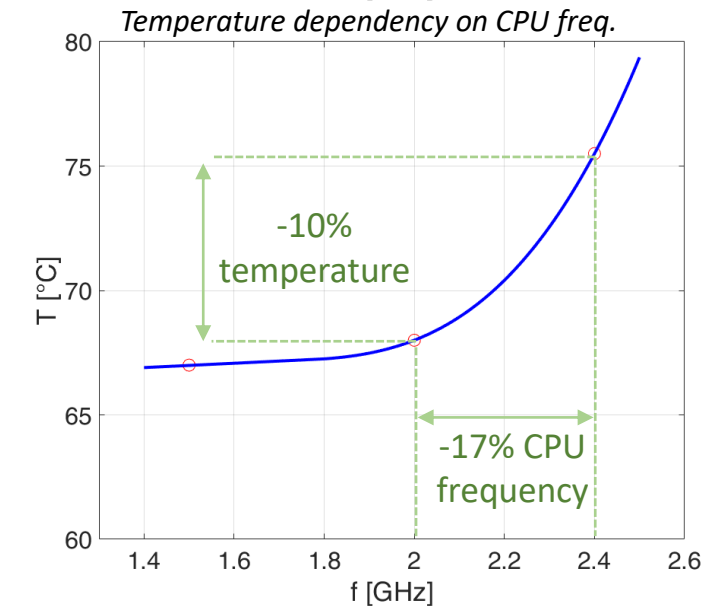
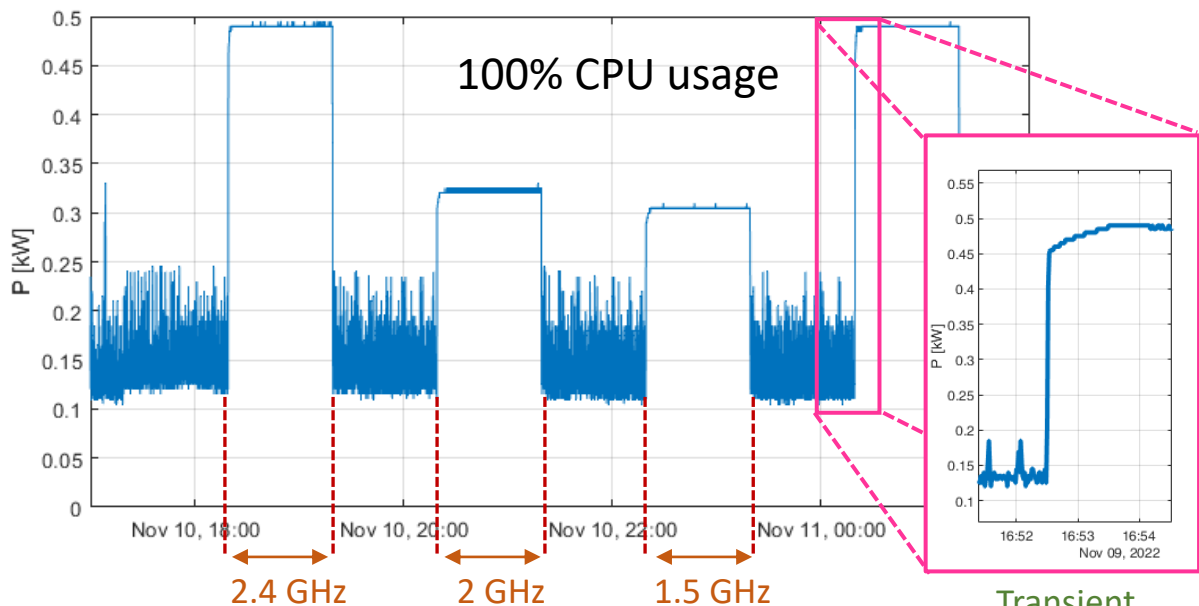
### Peak shaving

- Can be enabled by CPU performance control

### Ancillary services

- Fast transient dynamic (4s)
- Compliant with
  - FCR
  - aFRR

*Example of servers' power consumption during experiments*





- The energy crisis significantly impacts on the university's budget
- Opportunity to innovations and savings → more cost savings measures have positive business case
- Implementation of measures mainly depends on
  - *Internal factors*
    - User acceptance
    - Technical properties and possibilities of equipment
    - Organizational readiness
  - *External factors*
    - Investment incentives
    - Legal and market environment
    - and others

**Thank you for your attention ...**