The 4 Pillar Framework for Energy Efficient HPC Data Centers

- a foundation for energy efficiency efforts in high performance computing -

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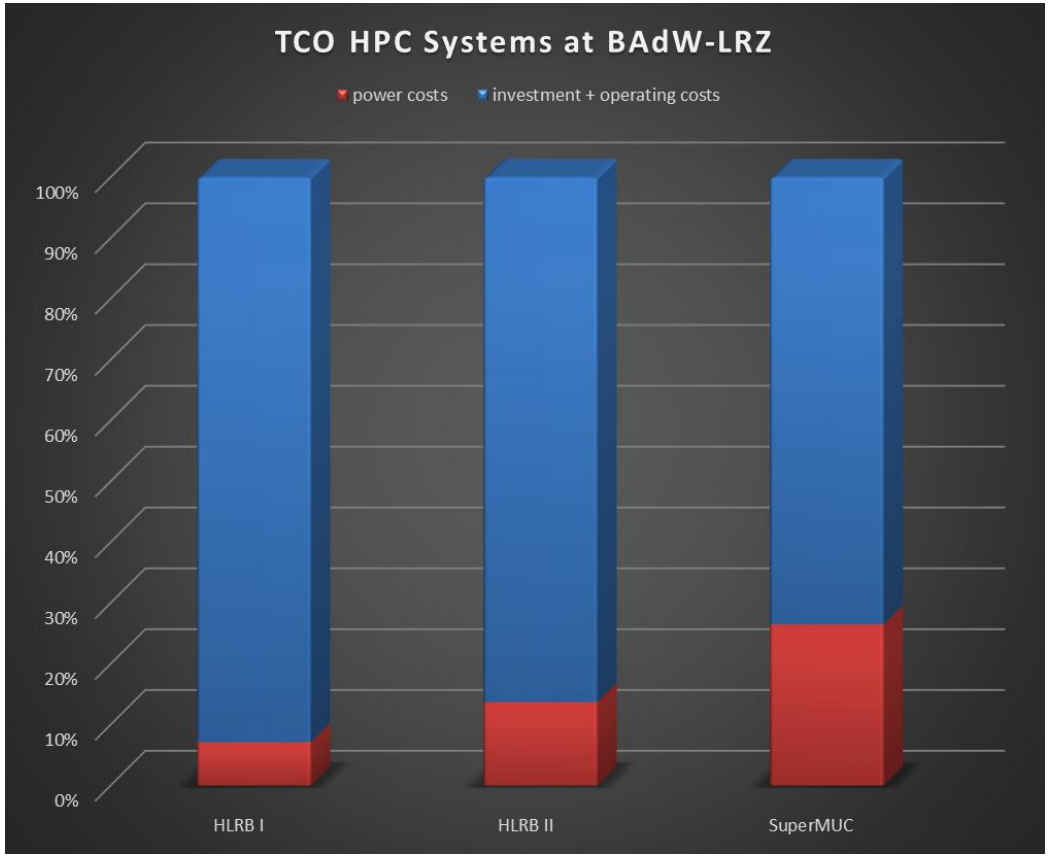
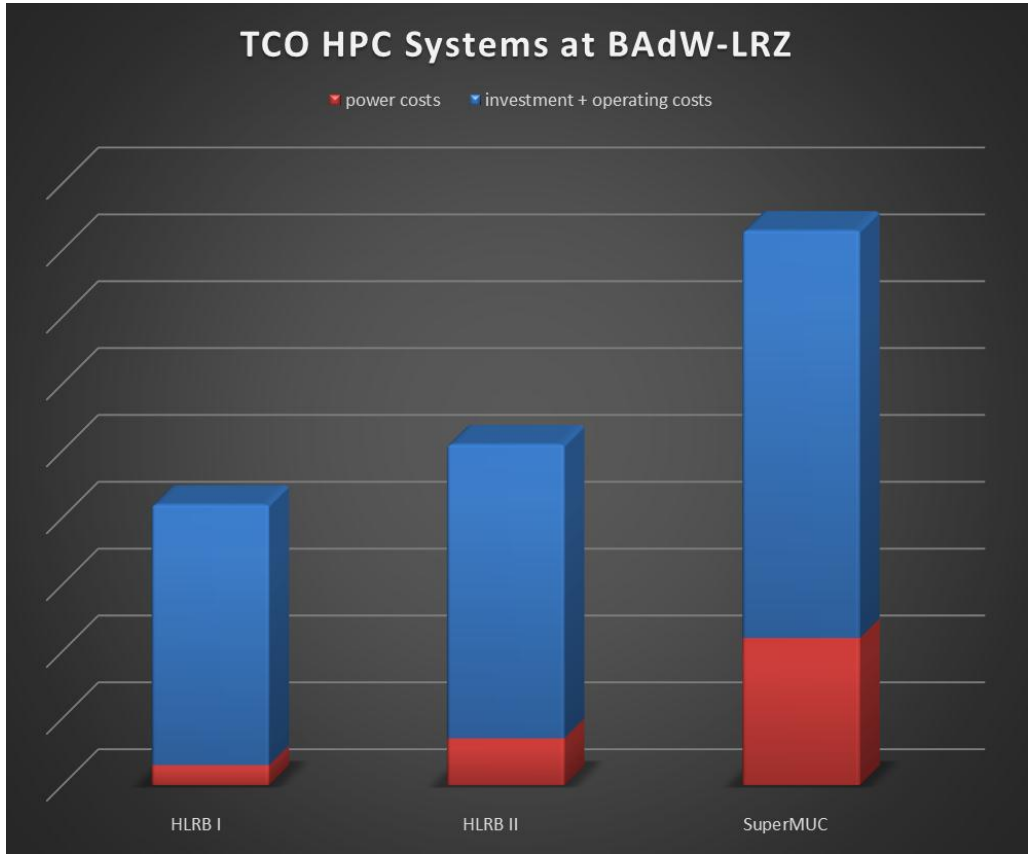
Outline

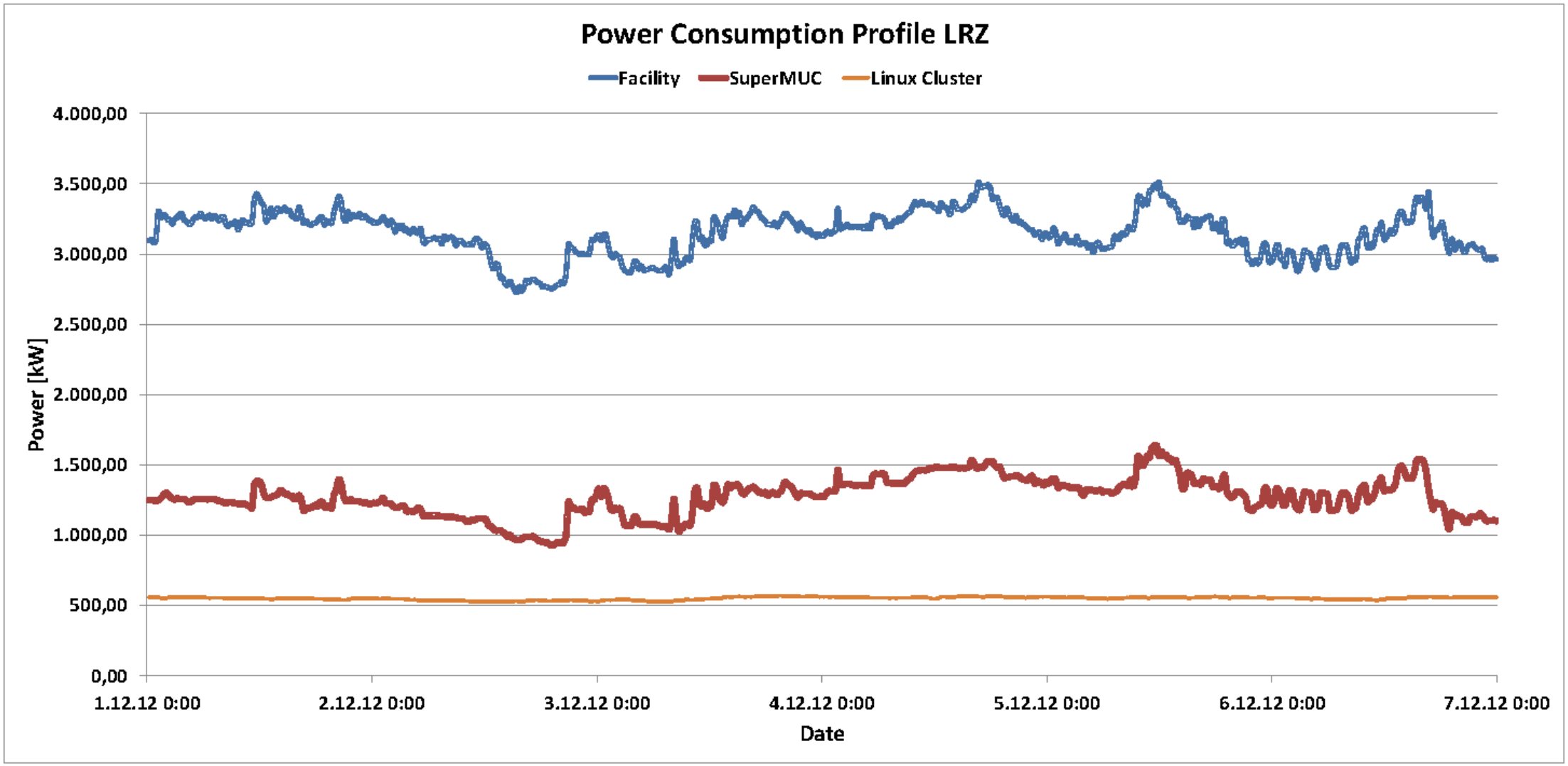
- ❑ Background
- ❑ 4 Pillar Framework
- ❑ Usage examples
- ❑ Summary

Why Care About Energy Efficiency ?





New challenges



The need for a foundation

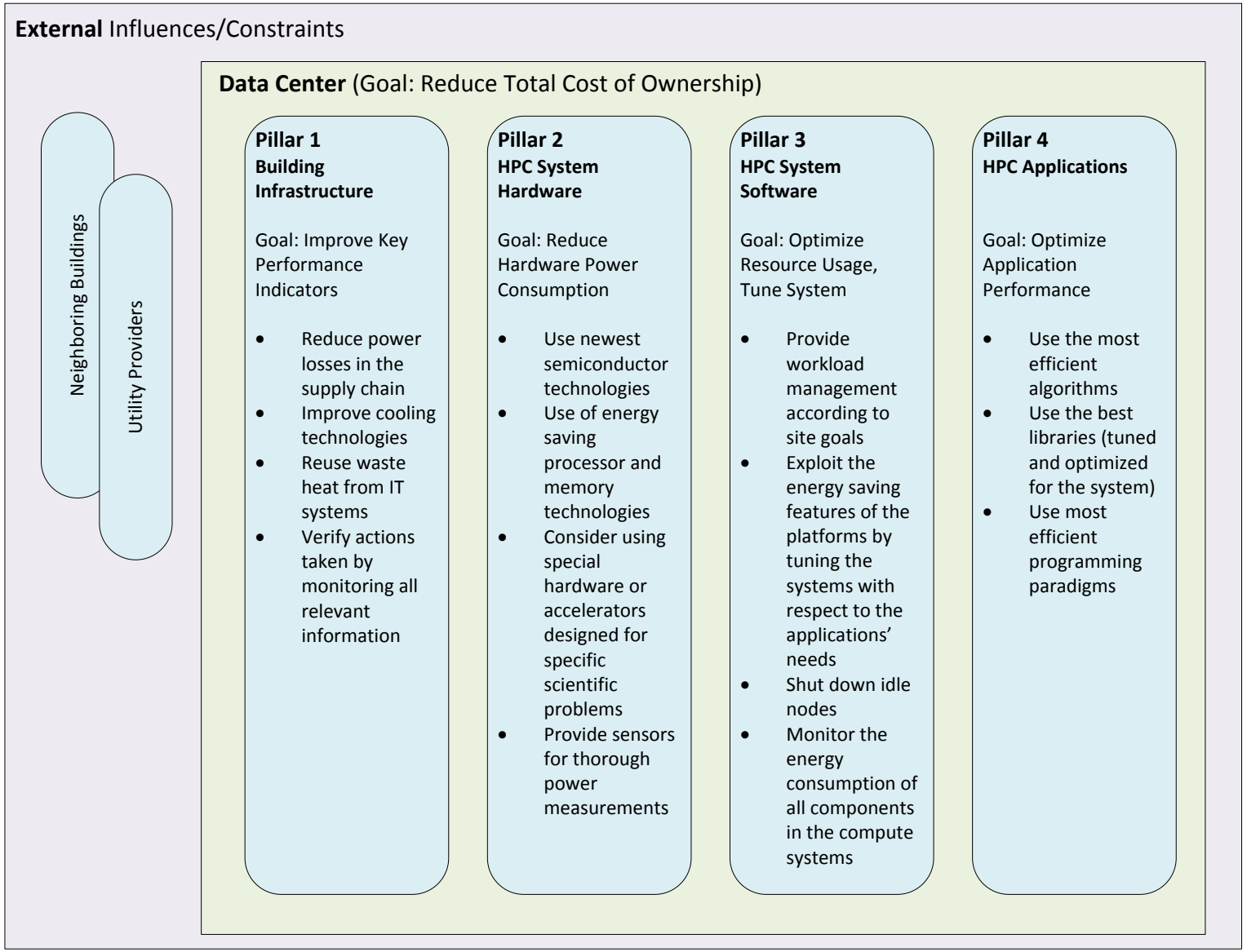
- **BAdW-LRZ data center goal: reducing the TCO for the lifetime of its HPC systems**
  - Questions to answer: What does it mean? What parts of your data center are involved? What are the inter-system connections? How to get there and where to start? What solutions exist?
- **Need a way to understand and categorize all internal and external efforts in the area of improving the data center energy efficiency.**
- **Need a foundation for:**
  - Defining final vision for BAdW-LRZ
  - Planning future work
  - Presenting current efforts to outside stakeholders

Towards the 4 Pillar Framework

- What HPC data center aspects play an important part for the improvement of energy efficiency?

- 1. Building Infrastructure
- 2. System Hardware
- 3. System Software
- 4. Applications

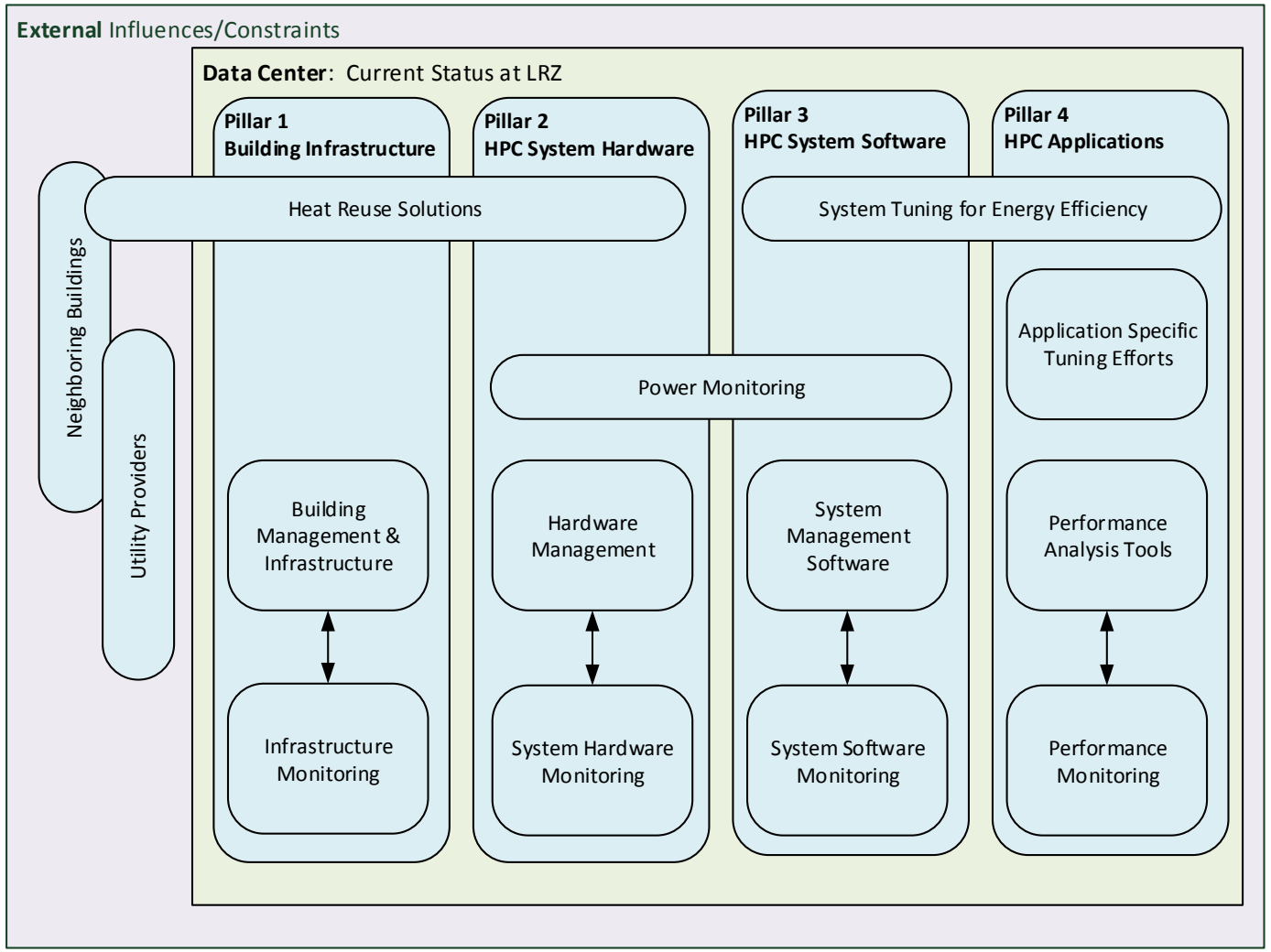
The 4 Pillar Framework - a foundation for energy efficiency efforts in high performance computing



The 4 Pillar Framework a tool for:

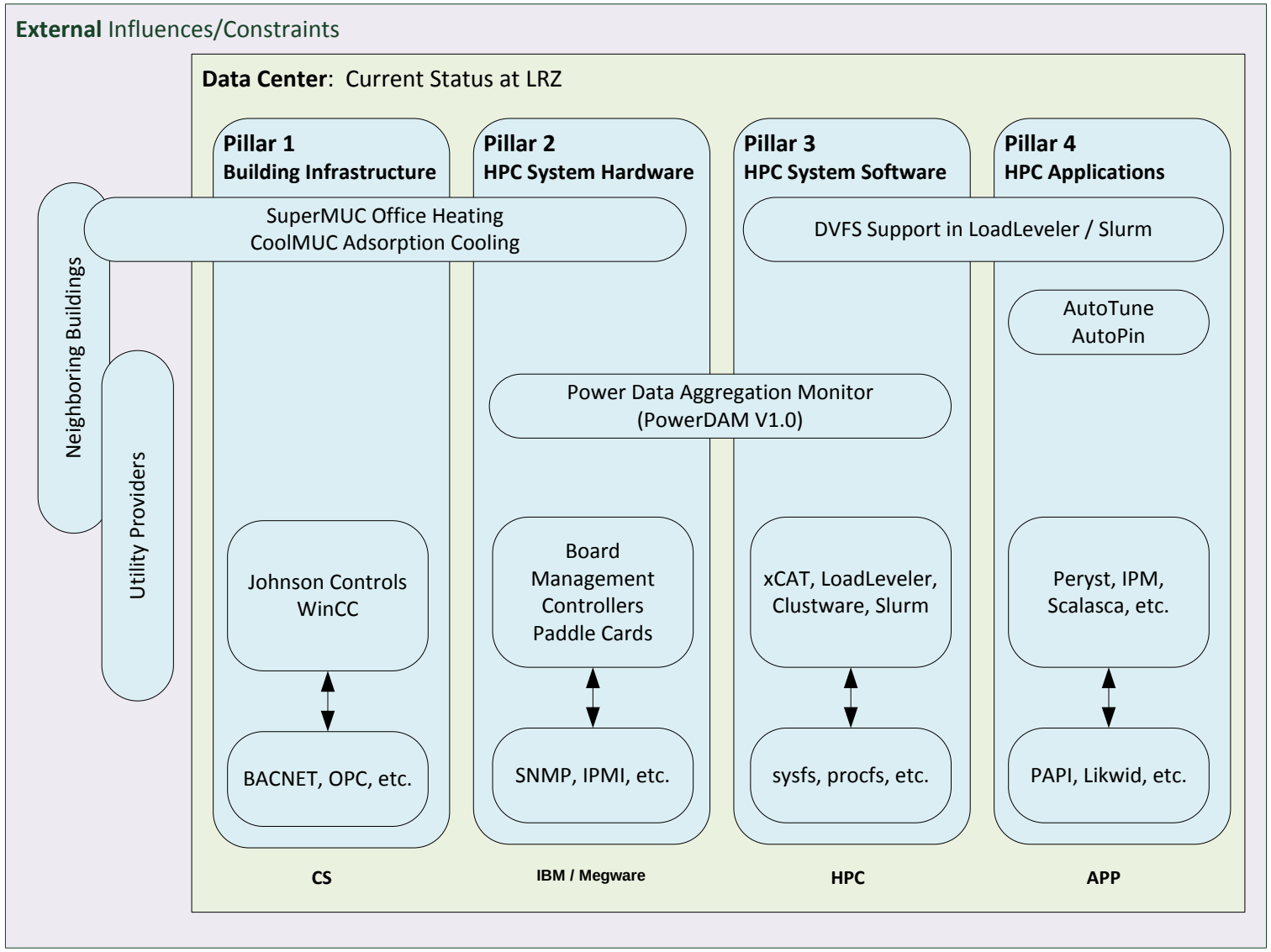
- **Operational Aspects:**
  - Identifying data center specific areas of improvement
  - Planning future work
  - Identifying required internal and external resources
- **Research Aspects:**
  - Classifying current research efforts (in paper)
  - Guiding energy efficiency efforts
- **Presenting results and plans to stakeholders**

How to plan your work - From general to specific, part 1

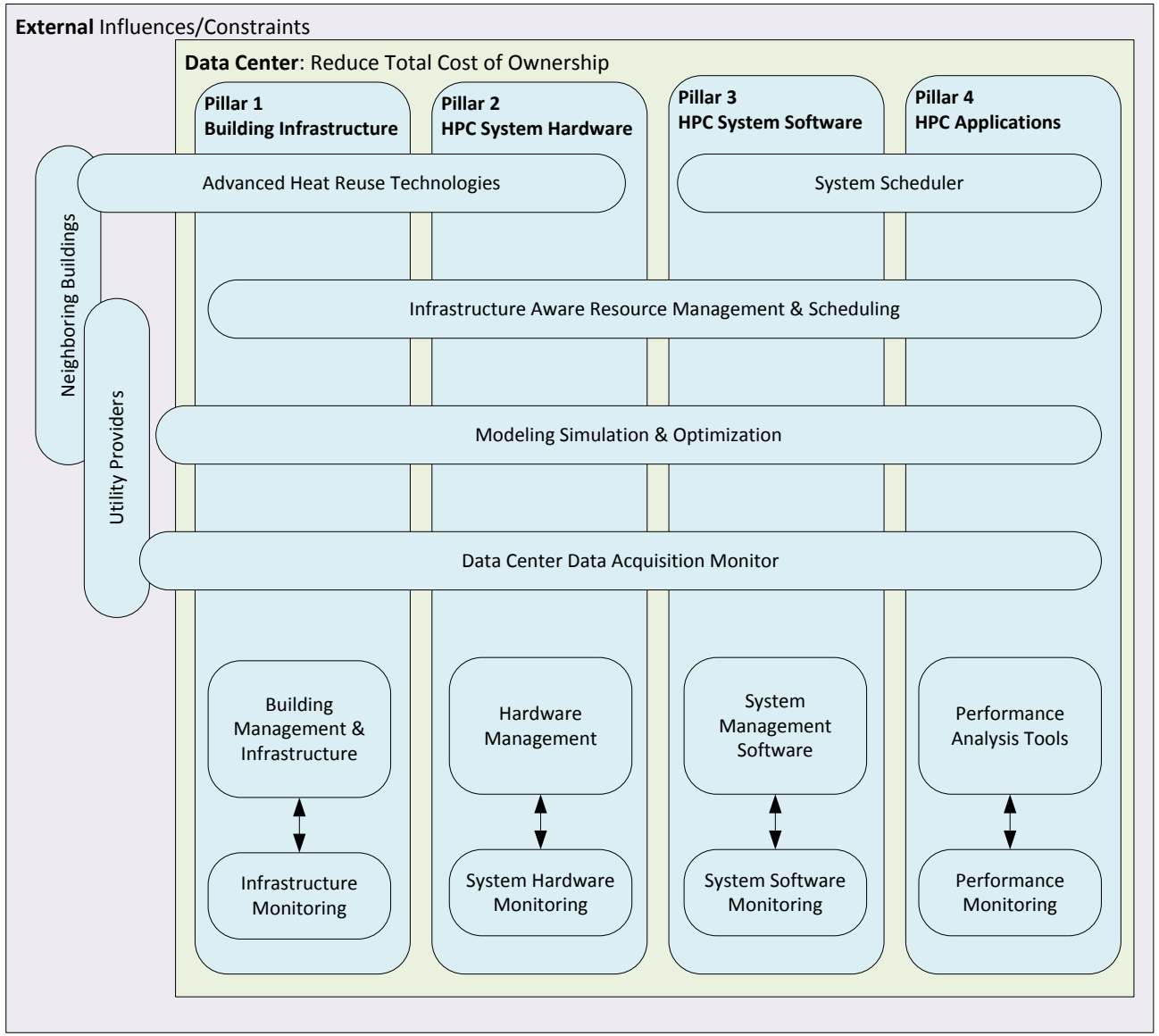


- PRACE PP and 1IP (CooLMUC) (EtS, adsorption cooling req. hot water cooling – SuperMUC, DVFS, energy efficient scheduling)

How to plan your work - From general to specific, part 2

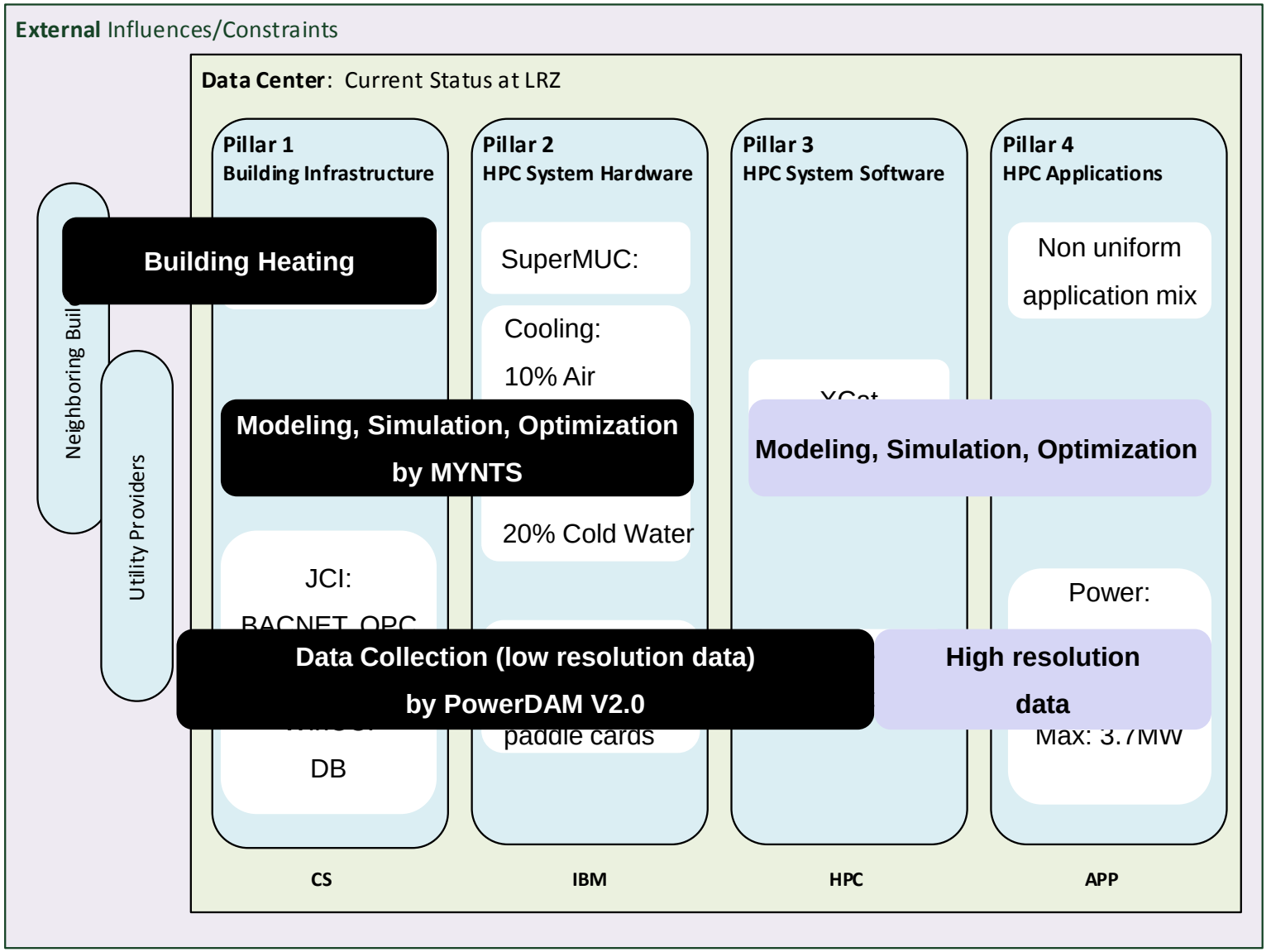


Energy Efficient Data Center Vision for BAdW-LRZ



- **What's your goal?**
- **What does it mean for your data center?**
- **Key Performance Indicators**
  - Energy To Solution (EtS)
  - Total Cost of Ownership (TCO)

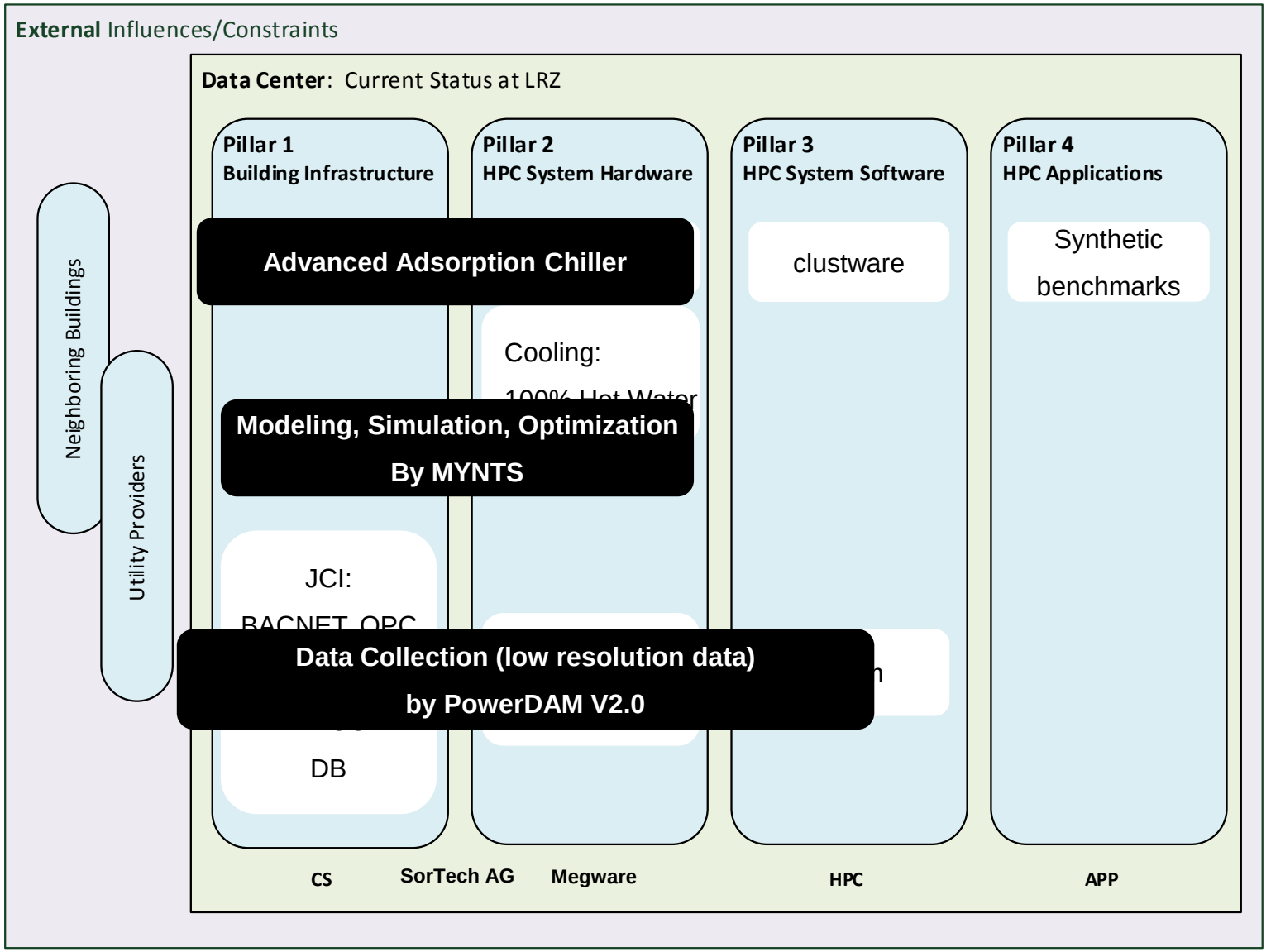
Next steps SIMOPEK and FEPA



SIMOPEK

FEPA

SIMOPEK 2nd Framework Instance



SIMOPEK

Links:

- **www.simopek.de**
- **PowerDAM paper:**
  - **ICT4S 2013:** http://dx.doi.org/10.3929/ethz-a-007337628
- **Open Access 4 Pillar Framework Paper:**
  - http://www.springerlink.com/openurl.asp?genre=article&id=doi:10.1007/s00450-013-0244-6

Summary

The 4 Pillar Framework is a tool for:

- ❑ **Identifying data center specific areas of improvement**
- ❑ **Planning future work**
- ❑ **Identifying required internal and external resources**
- ❑ **Classifying current research efforts (in paper)**
- ❑ **Guiding energy efficiency efforts**
- ❑ **Presenting results and plans to stakeholders**

Why use the 4 Pillar Framework ?

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