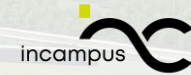Technische Hochschule Ingolstadt
Institute of new Energy Systems

In cooperation with PGMM GEBÄUDE.TECHNIK.DENKEN incampus Audi

MODERN BENCHMARK OF ADAPTIVE THERMAL SOURCE NETWORK AT AN INDUSTRIAL SITE

The incampus

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Agenda

1. Introduction

2. **General System Description**

3. **Envisaged Operation**

4. **First Monitoring Results**

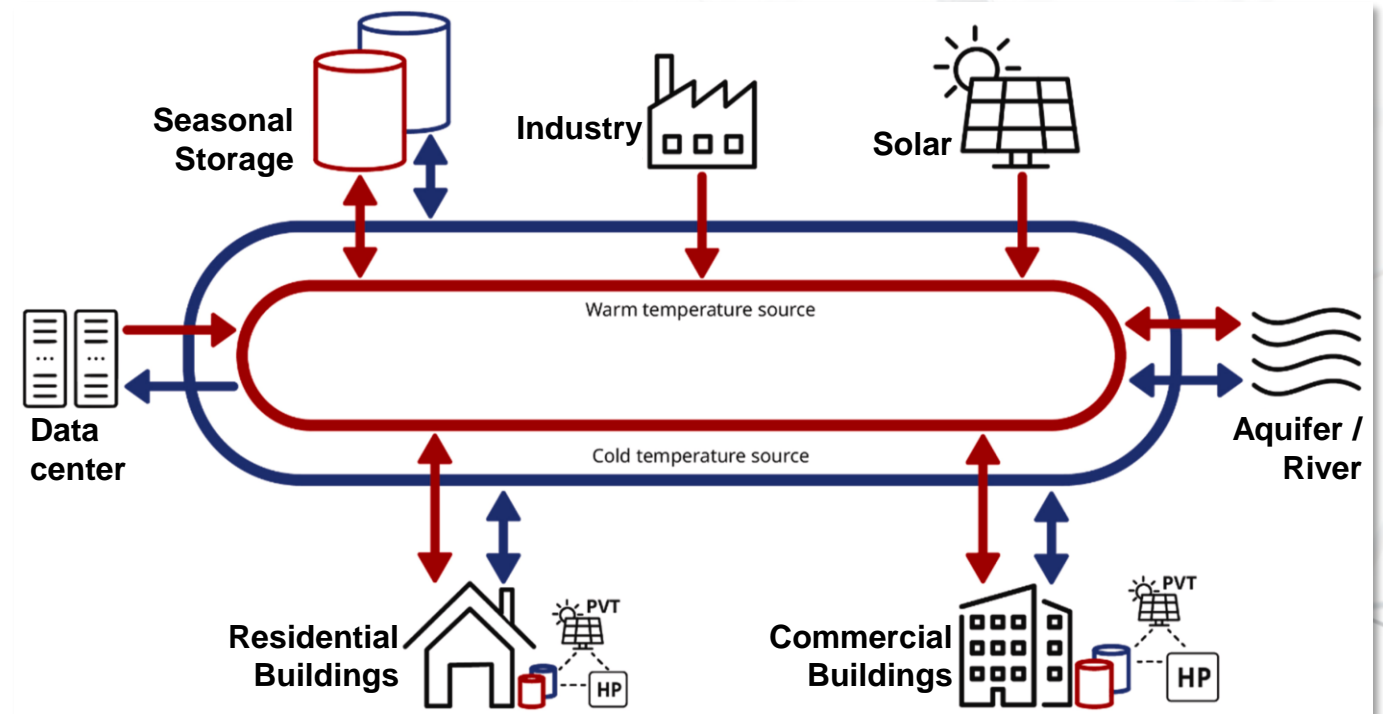5. **Technical Project Planning**

6. Conclusion & Outlook

1. INTRODUCTION

Thermal Source Networks

"Networks that are mainly used as a source for heating and cooling by decentralized technologies such as heat pumps." [1]
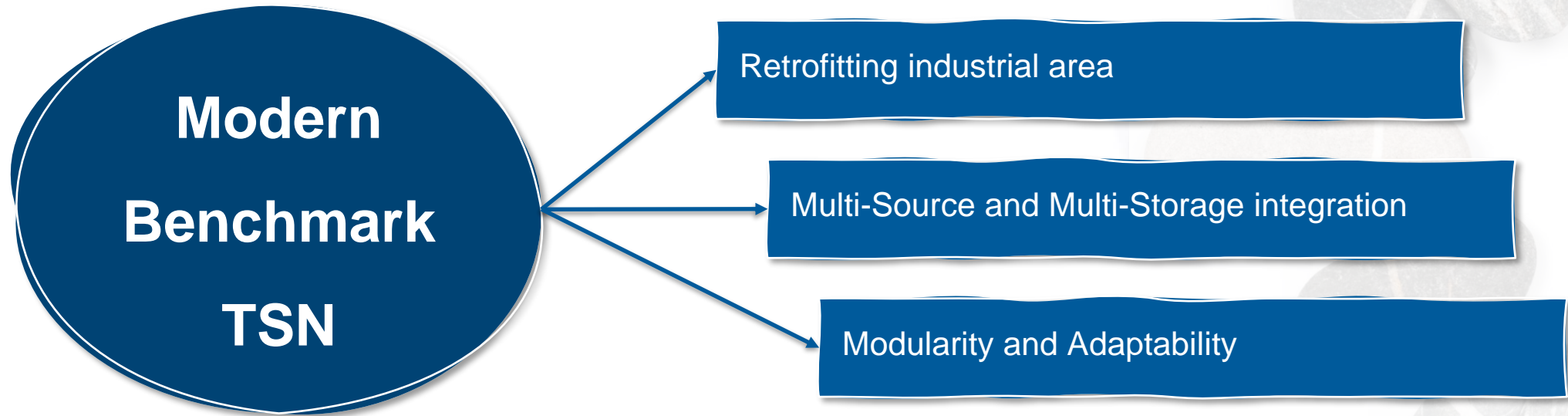
➢ Low network temperature level
- Easy integration of renewable energy

➢ Heating and cooling via same infrastructure
- High energy efficiency

Conceptual representation of a TSN [2]

Modern Benchmark TSN

Modern Benchmark TSN

Retrofitting industrial area

Multi-Source and Multi-Storage integration

Modularity and Adaptability

2. SYSTEM DESCRIPTION

The incampus

3D-model of the incampus industrial park [3]

The incampus:

➢ Planned 75 ha industrial park (mixed-use)

  (up to 70 non-residential buildings)

➢ Located in Ingolstadt, Germany

Location of Ingolstadt

incampus before refurbishment

Photograph of former refinery site in Ingolstadt (before refurbishment)

Former refinery site:

➢ Began operation 1965

➢ Stopped operation 2008

➢ Area sold in 2015

2. System Description

incampus during refurbishment
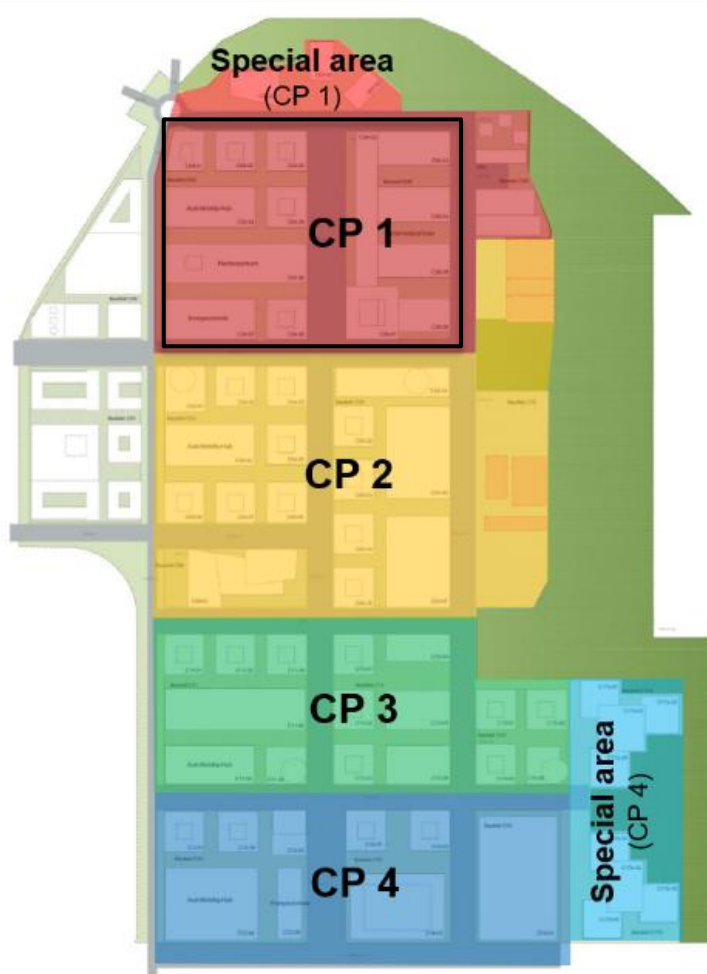

Soil remediation process

➤ Air sparging & Soil washing

Old fire extinguishing basin

Groundwater wells & treatment

Photograph of former refinery site in Ingolstadt (during refurbishment)

2. System Description

Current State

Site plan of the incampus area with indication of construction phases (CP) (modified after [4])

View on incampus buildings of first construction phase [3]

The IN-Campus:

➢ Four construction phases (CPs) planned

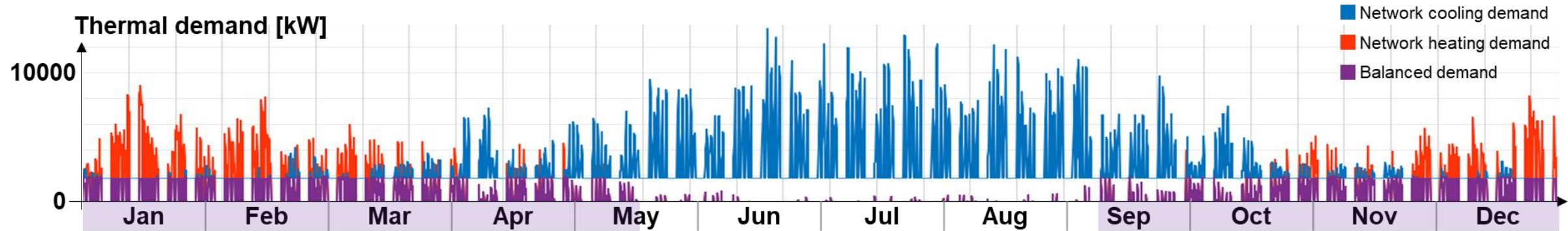➢ Buildings of first construction phase in operation as of September 2023

3. ENVISAGED OPERATION

Demand

First construction phase (CP1) → 12 Buildings

- ➢ 7 GWh of heating demand

- ➢ 26 GWh of cooling demand
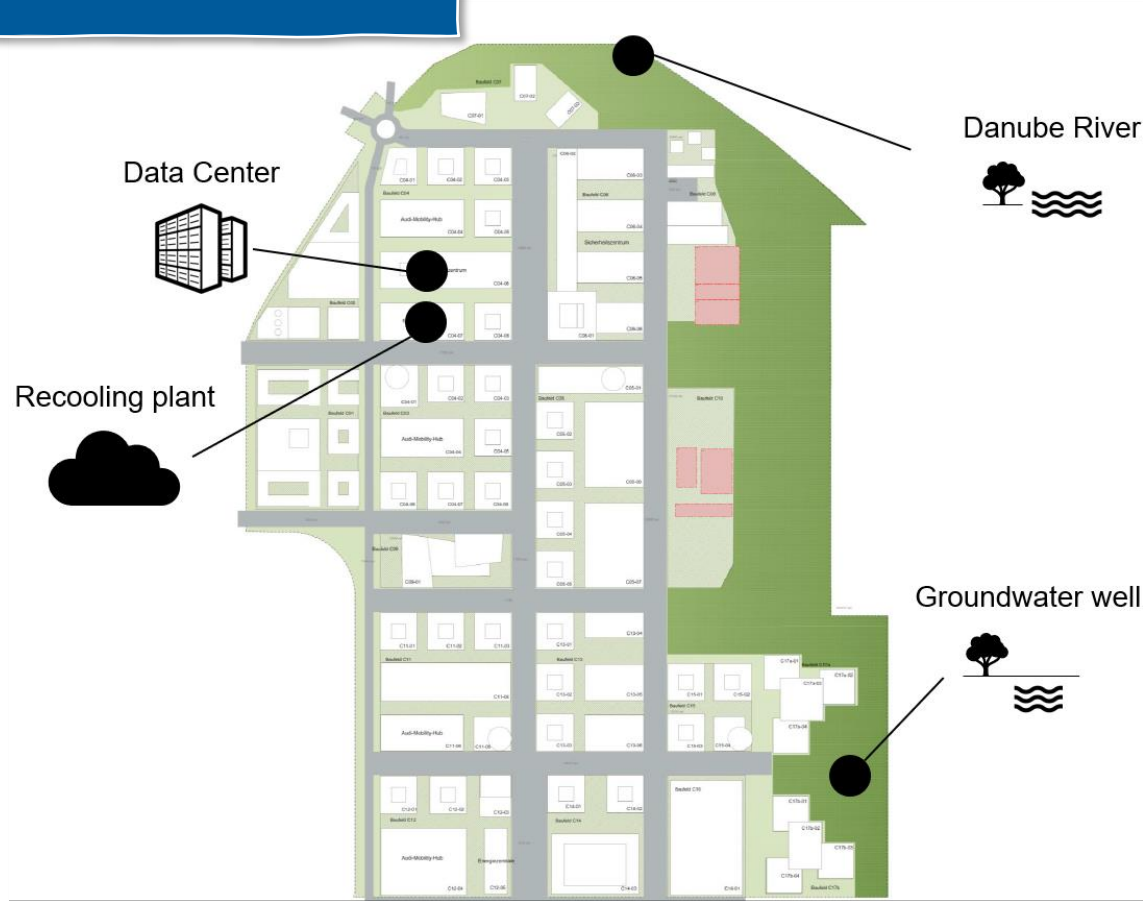
  - ▪ Incl. waste heat from data center

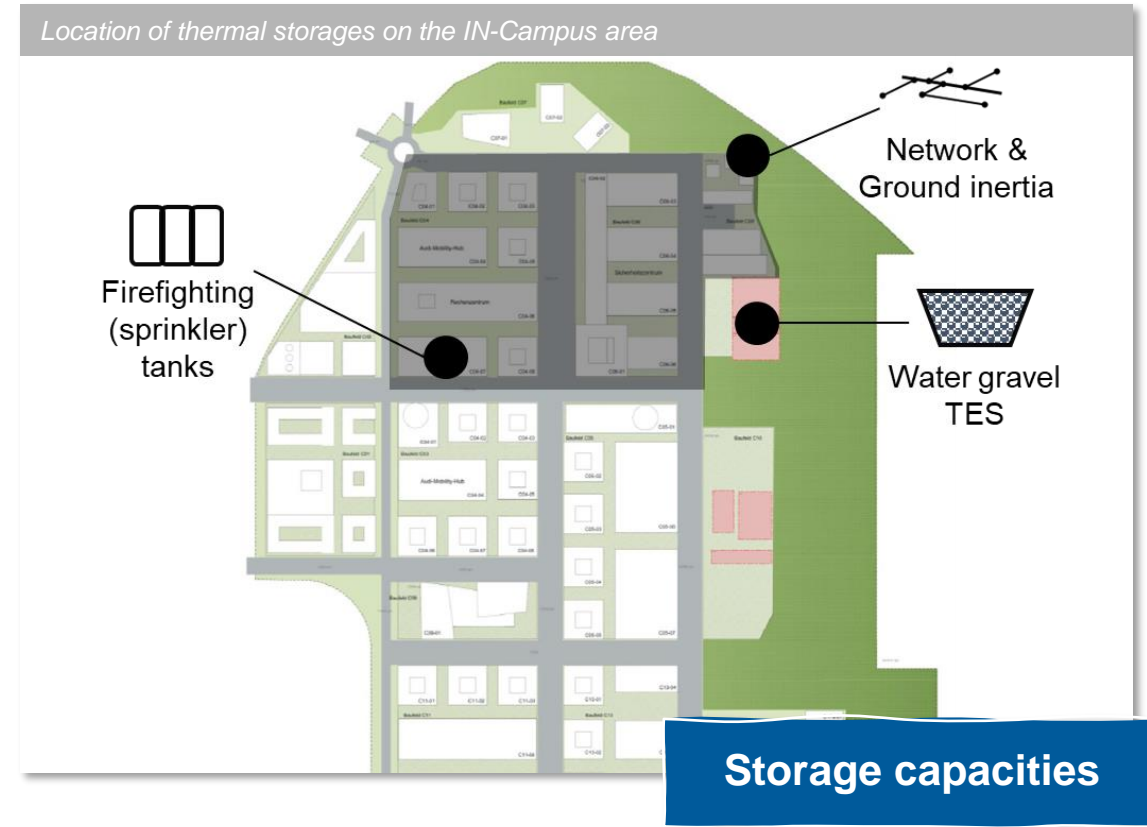*Overview of the sum of thermal energy demand profiles of the buildings of CP1*

Energy Sources and Sinks, and Storage Capacities

Sources & Sinks

Data Center

Danube River

Recooling plant

Groundwater well

Location of thermal sources and sinks on the IN-Campus area [4]

Storage capacities

Location of thermal storages on the IN-Campus area

Network & Ground inertia

Firefighting (sprinkler) tanks

Water gravel TES

Energy Flows

TSN

Winter

Waste heat

Buildings

*Thermal
Sources/Sinks*

Storages

Ø =
710 mm

Energy Flows

Winter — Transition period — Summer

Waste heat

Thermal Sources/Sinks

Buildings

Storages

Heat

Cold

4. FIRST MONITORING RESULTS

Heating and Cooling Energy – Supply and Demand
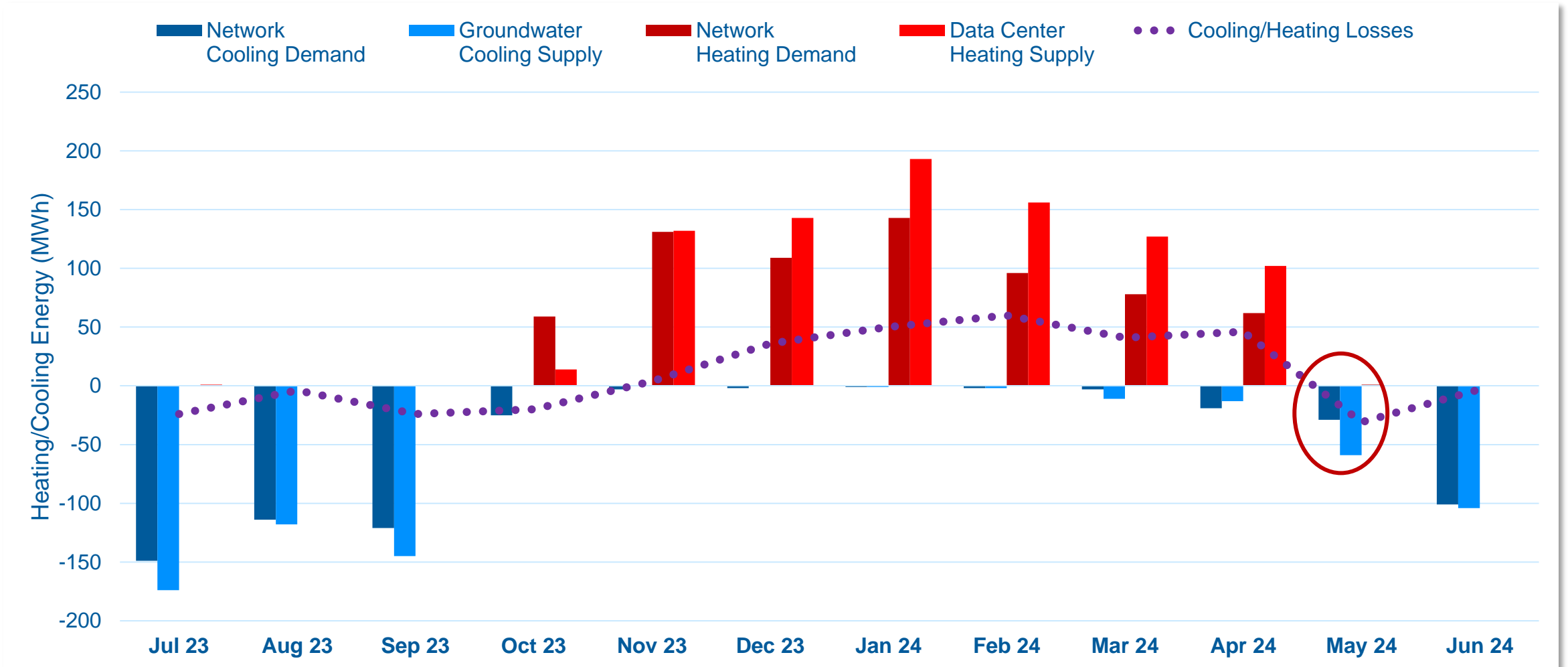
5. TECHNICAL PROJECT PLANNING

5. Technical Project Planning

Variant comparison of 1-,2-,3-pipe system as exemplary planning step
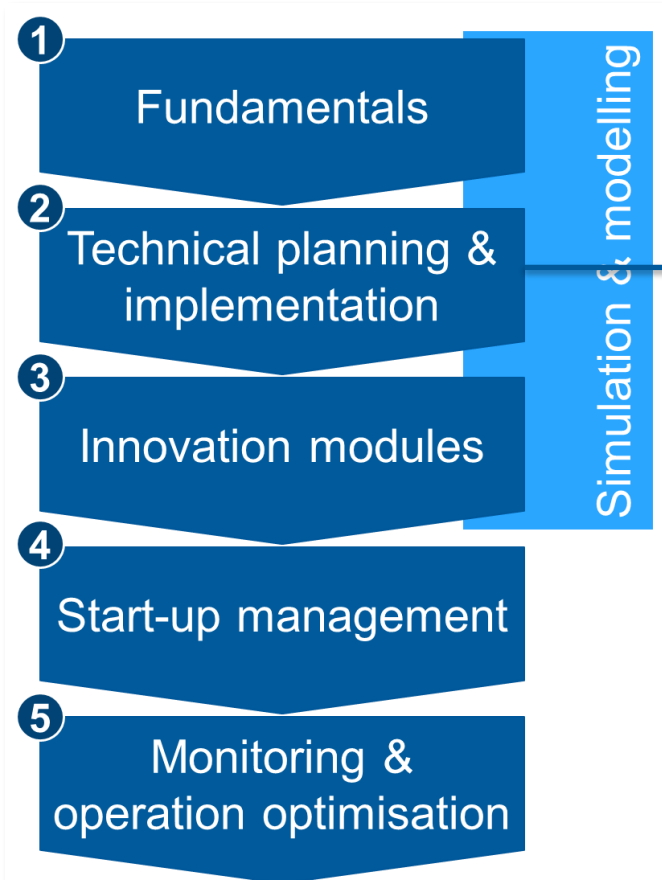
Phases of technical project development at incampus

Ranking of network types (modified after [5])

	1-pipe system	2-pipe system		3-pipe system
		Unidirectional	**Bidirectional**	
Costs	+	o	-	- -
Efficiency	o	o	+	+(+)
Control	o	+	o	-
Complexity of installation	+	+	o	o
...				

6. CONCLUSION & OUTLOOK

Conclusion

➢ Incampus presents benchmark properties in terms of

▪ Retrofitting

▪ Multi-source / multi-storage integration

▪ Modularity

Outlook

➢ Show transferability to other sites

➢ Establish continuous / extended energy monitoring

➢ Control systems, etc.

INTER
STORES

References

[1] IEA DHC. District heating network generation definitions; 2024.

[2] Gjoka K, Rismanchi B, Crawford RH. Fifth-generation district heating and cooling systems: A review of recent advancements and implementation barriers. Renewable and Sustainable Energy Reviews 2023;171:112997.

[3] incampus | Audi MediaCenter. [July 18, 2024]; Available from: https://www.audi-mediacenter.com/de/fotos/album/incampus-1205.

[4] Müller SN, Strobel R, Faigl M, Schrag T. Analysis of Industrial 5GDHC System in Ingolstadt. 2976-2030 2024;1.

[5] Sommer T, Sotnikov A, Sulzer M, Scholz V, Mischler S, Rismanchi B et al. Hydrothermal challenges in low-temperature networks with distributed heat pumps. Energy 2022;257:124527.