# Energetic Assessment of Water Loop Systems for Supermarket Refrigeration

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# Agenda

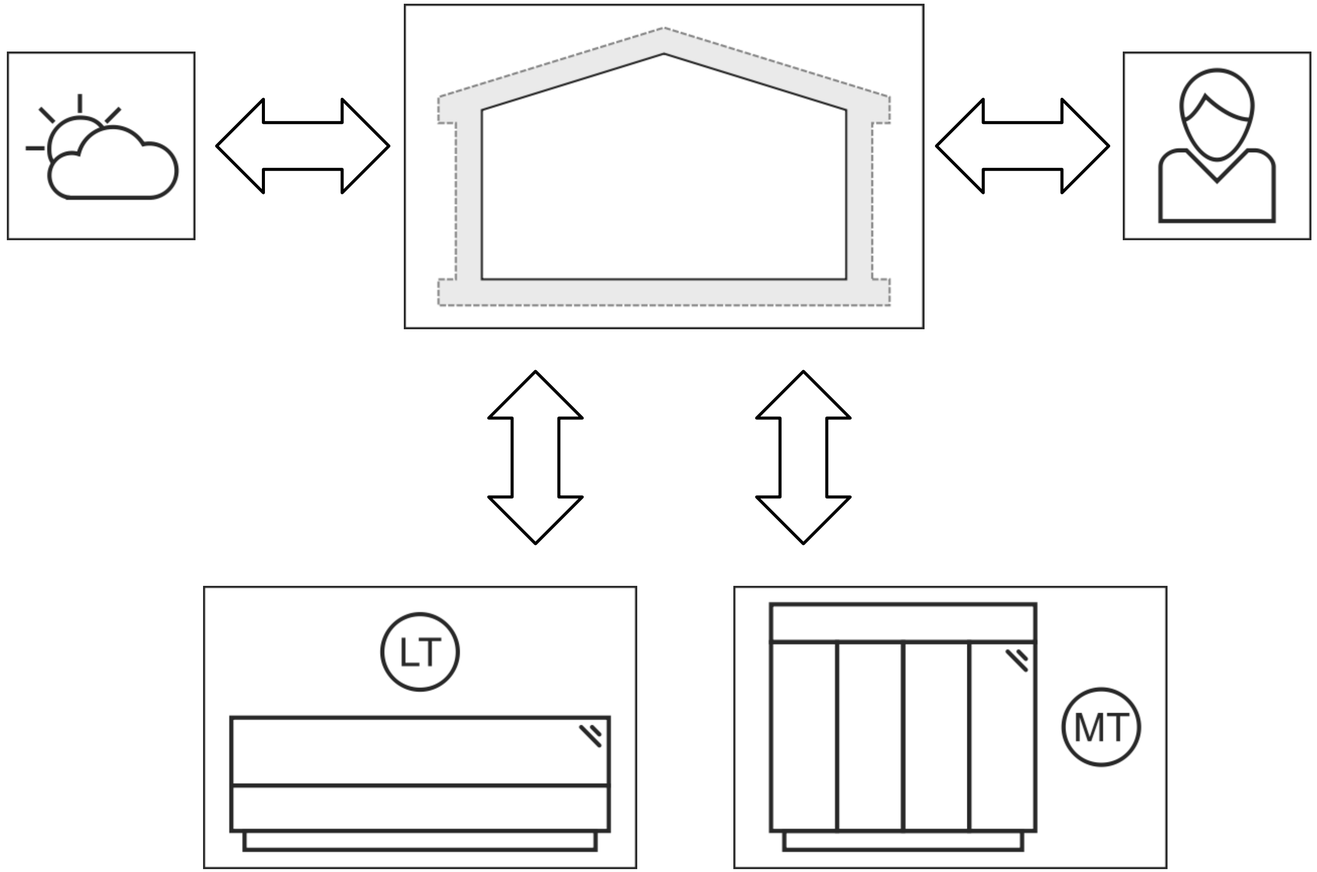
- Introduction
- Focus of Research and Simulation Technology
- Case Study
- Summary

# Introduction

Topic PhD-Thesis:
*“Energetic Assessment of Innovative Supermarket Concepts”*

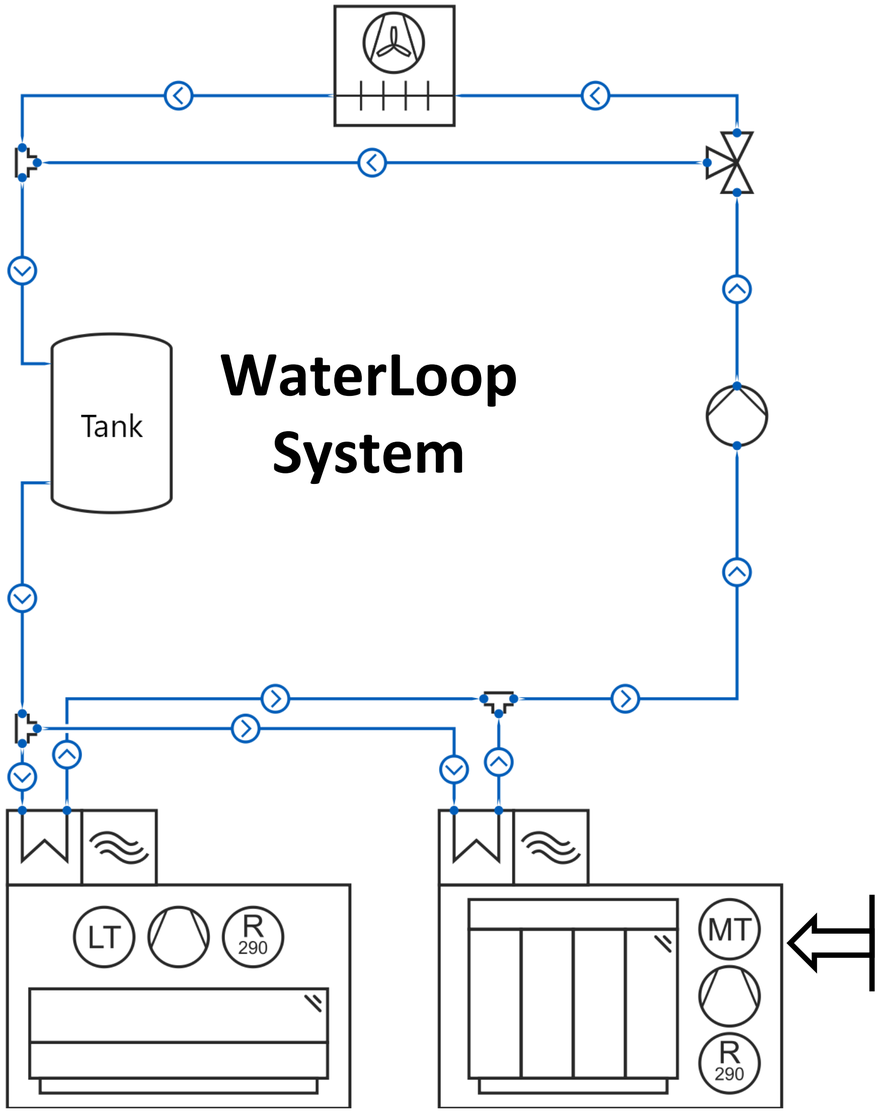
Focus of work

- Advanced Simulation Technology
- Consideration of all Relevant Thermal Interactions
- Development of new computational tools for:
  Planners, Operators, Manufacturers…




**Today: Waterloop systems**

# Introduction

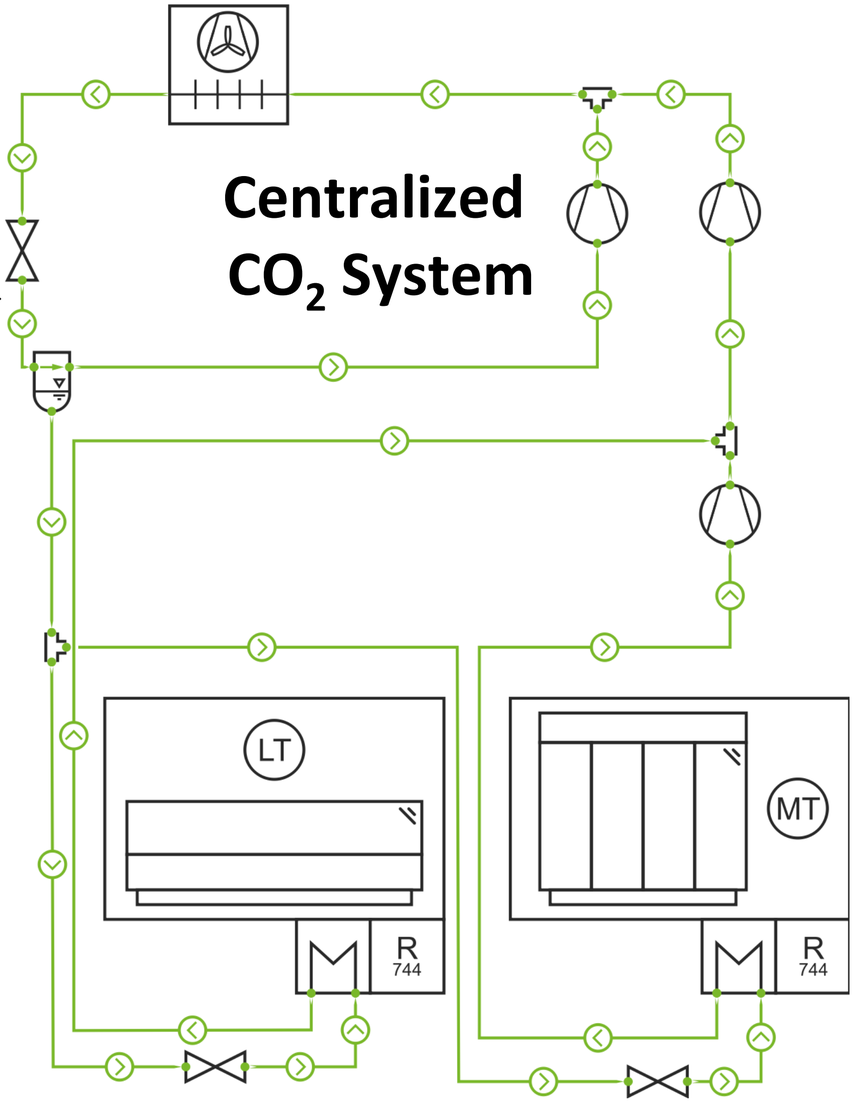



**WaterLoop System**

**In the machine room**

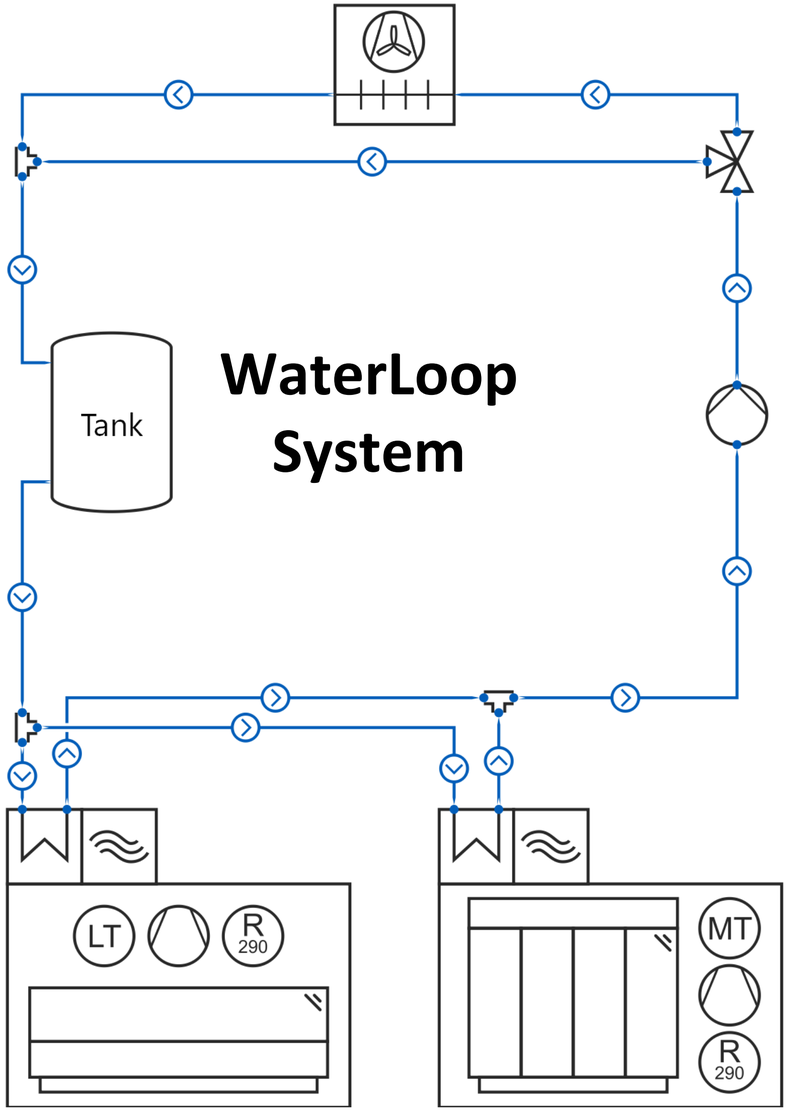
Location of the Refrigeration System

**In each cabinet**




**Centralized $CO_2$ System**

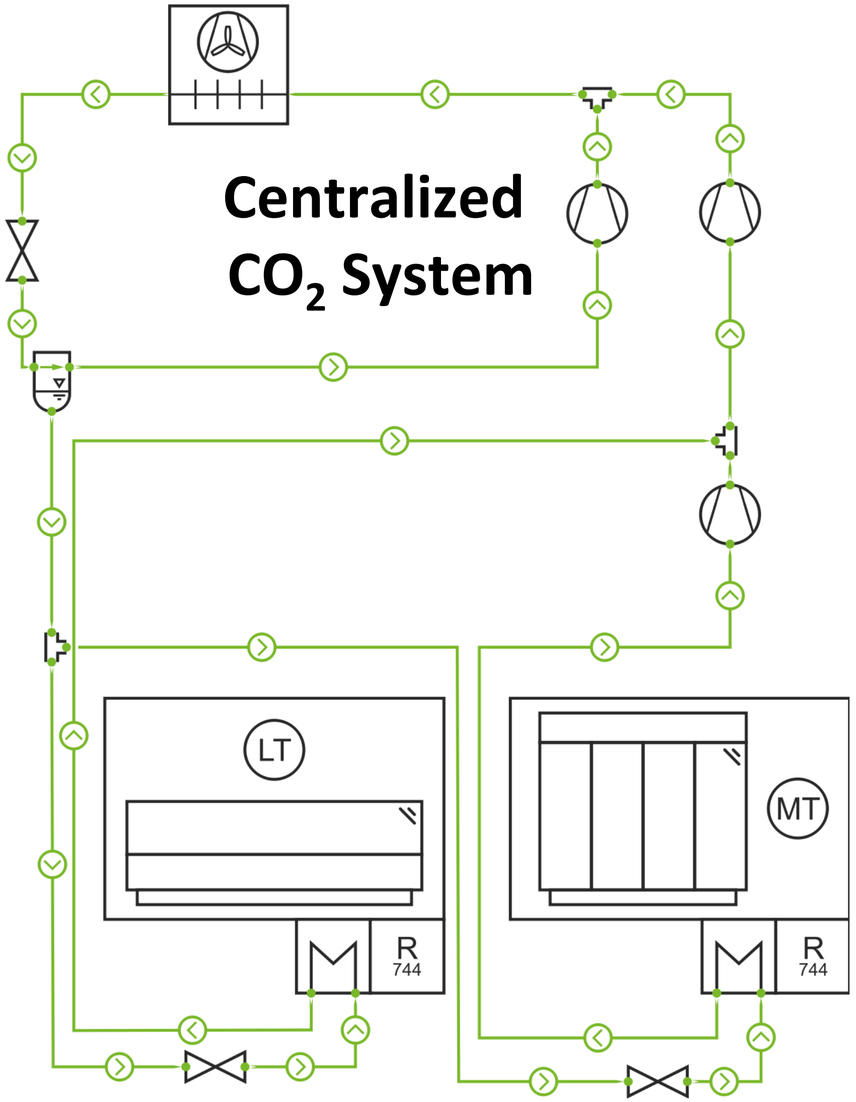
# Introduction



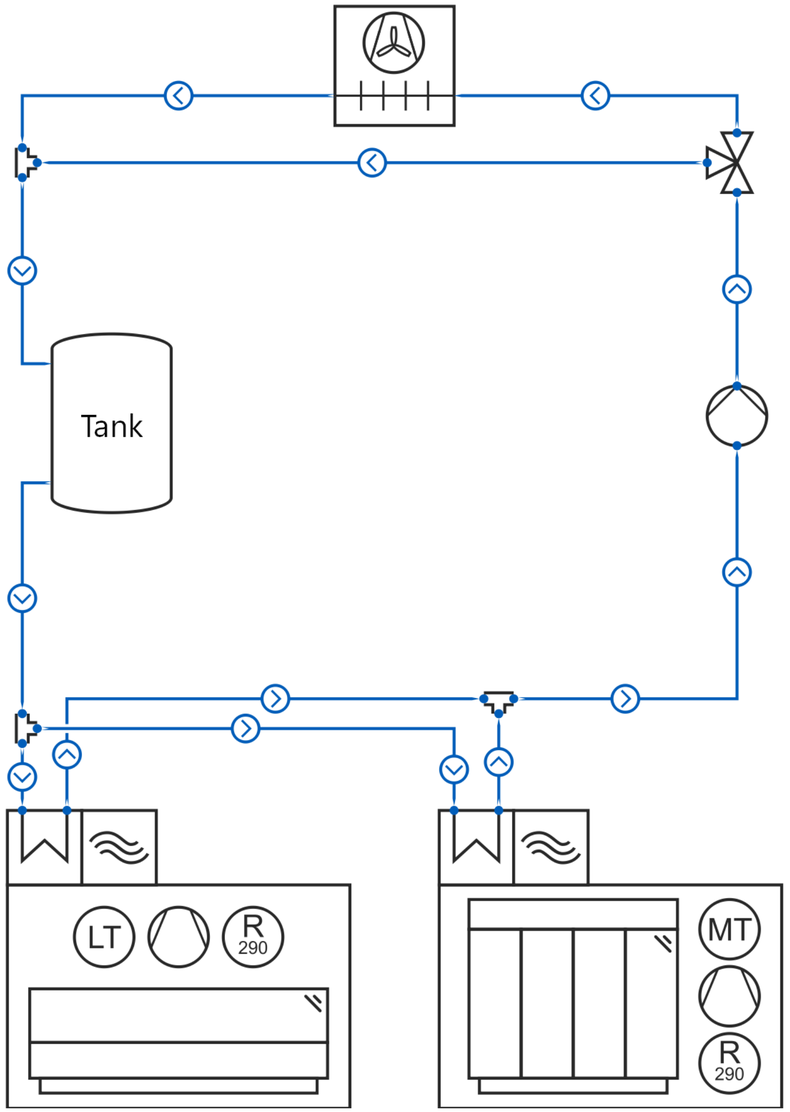

⇩ Refrigerant charge ⇧

⇩ Complexity ⇧

? Efficiency ⇧



# Focus of Research and Simulation Technology




System layout

Refrigerant

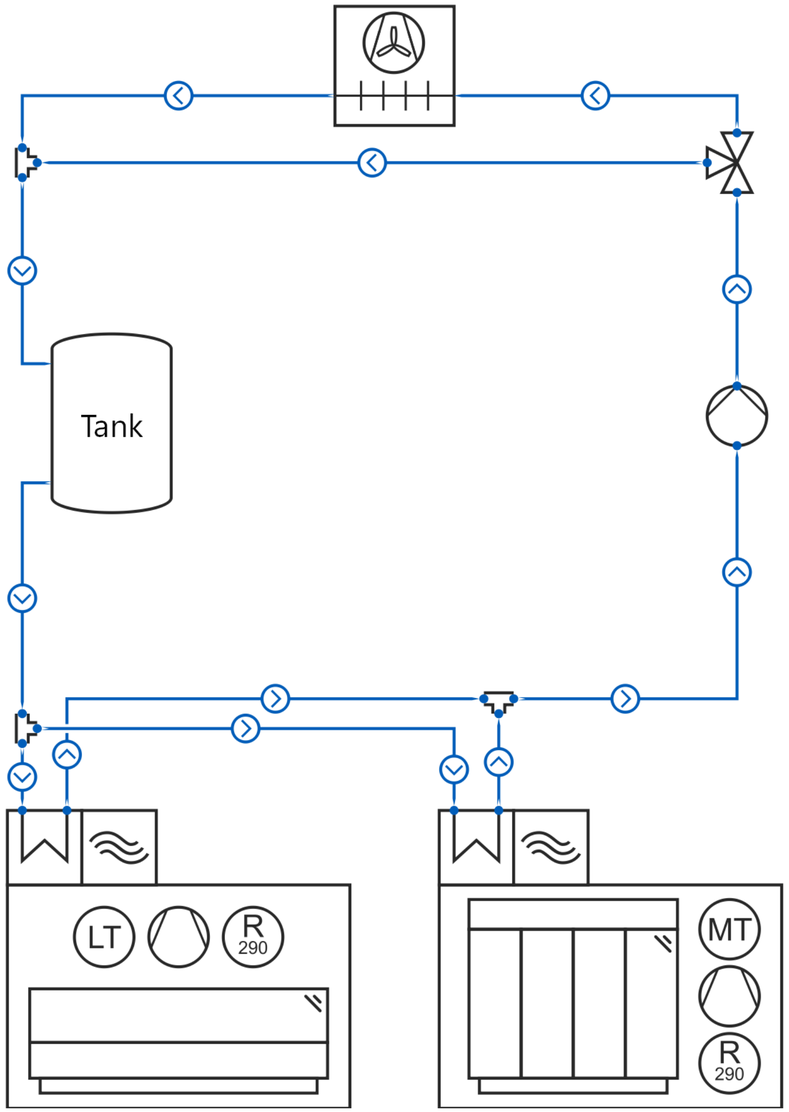
$CO_2$ vs. Propane

Optimization potential

Planning Methodology

Components Selection

# Focus of Research and Simulation Technology



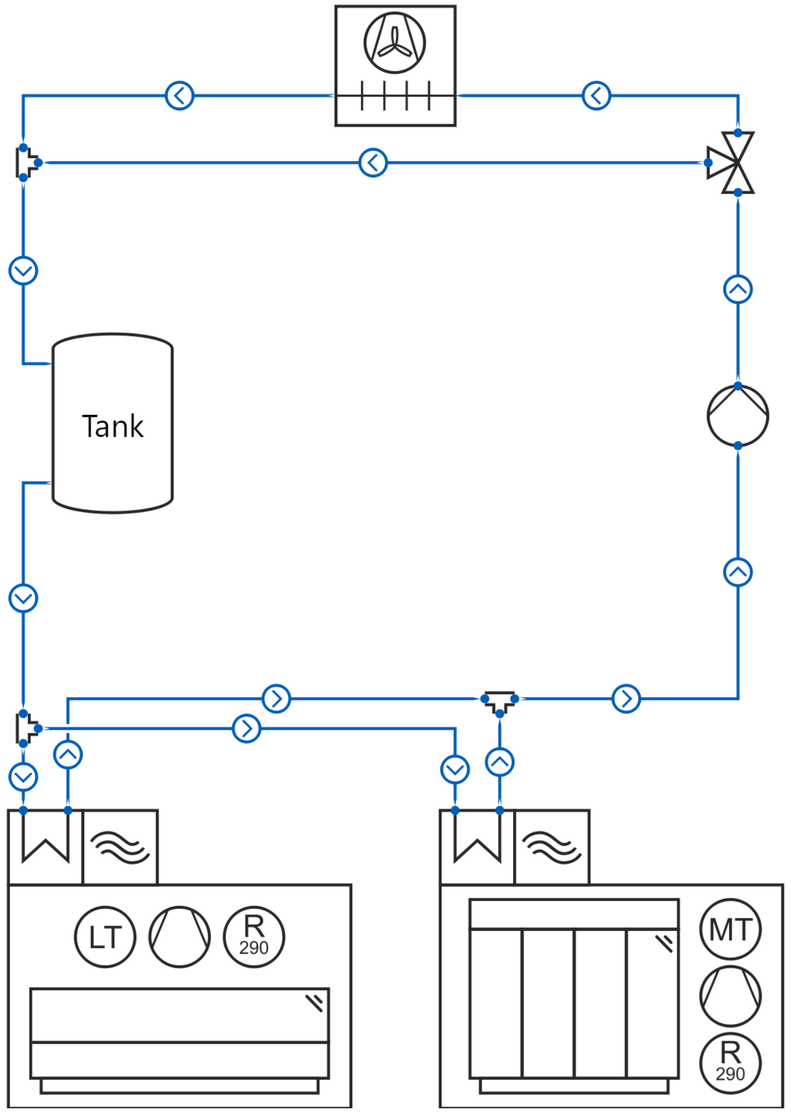

## Simulation

- Object oriented
- Transient
- Technology based on open standard

## Features

- New system layout can be built up easily
- In depth analysis the systems is possible
- Simulation of entire years is possible

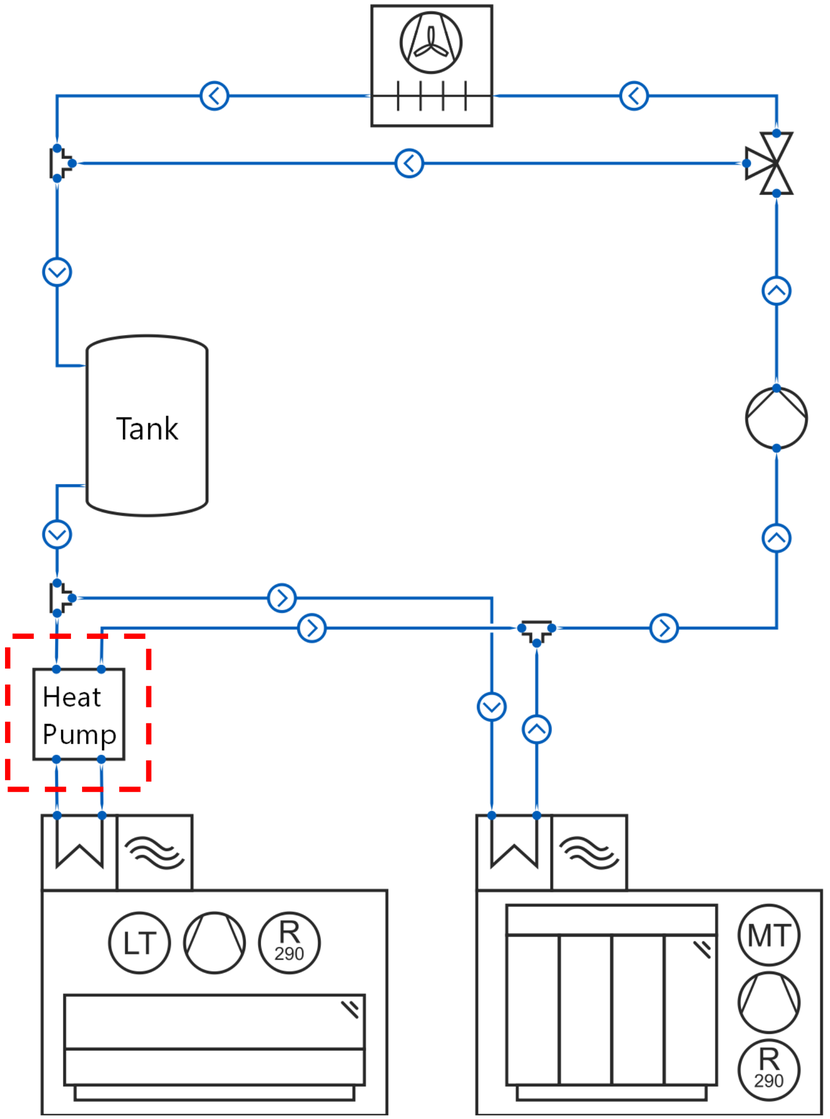
# Focus of Research and Simulation Technology



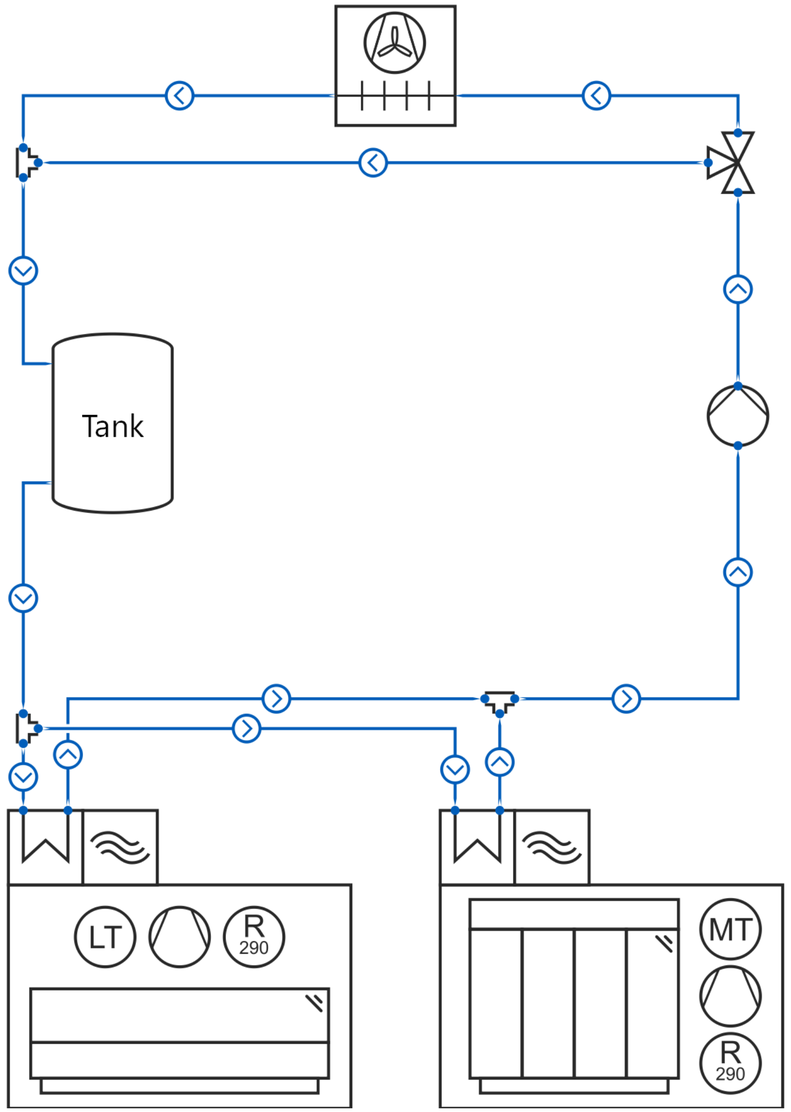

$> 35°C$

**Problem:**
Fluid temperature too high for LT-cabinet

**Solution:**
Adding a heat pump ⟹



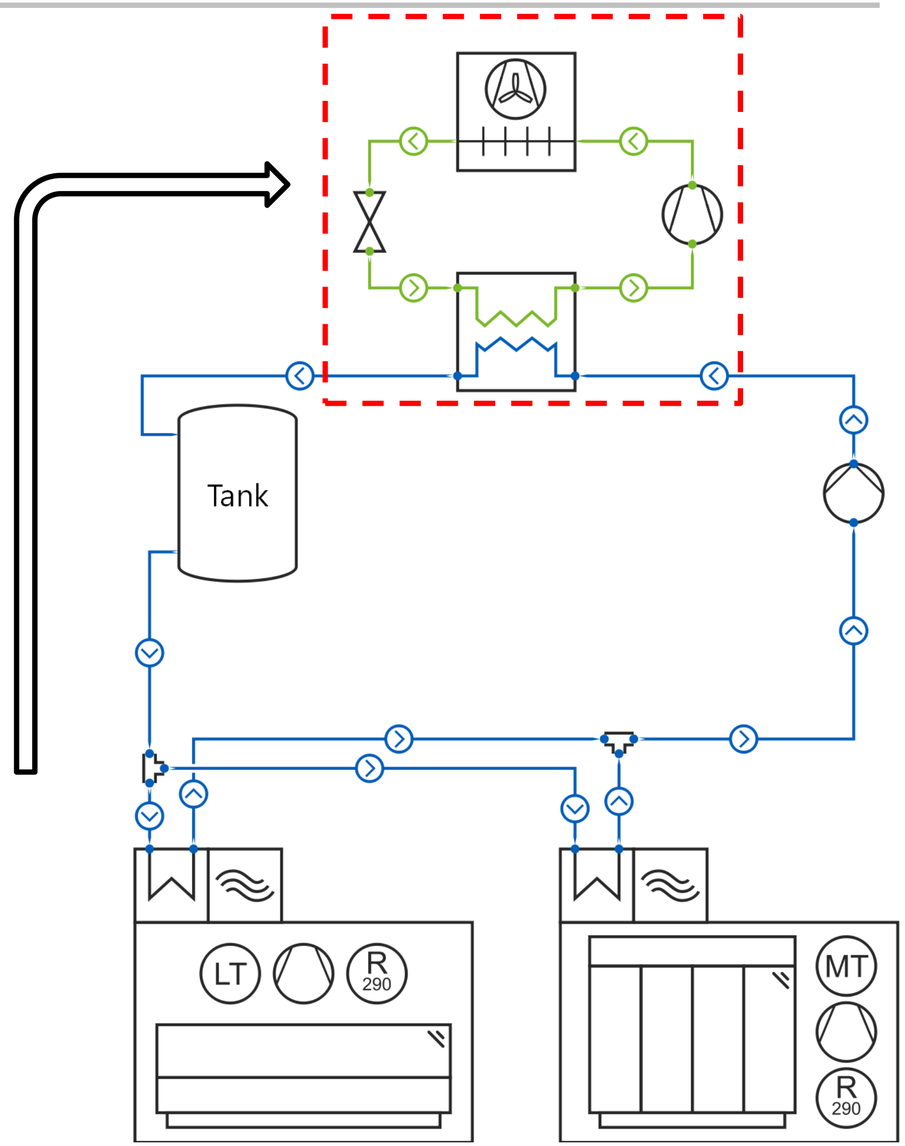
# Focus of Research and Simulation Technology



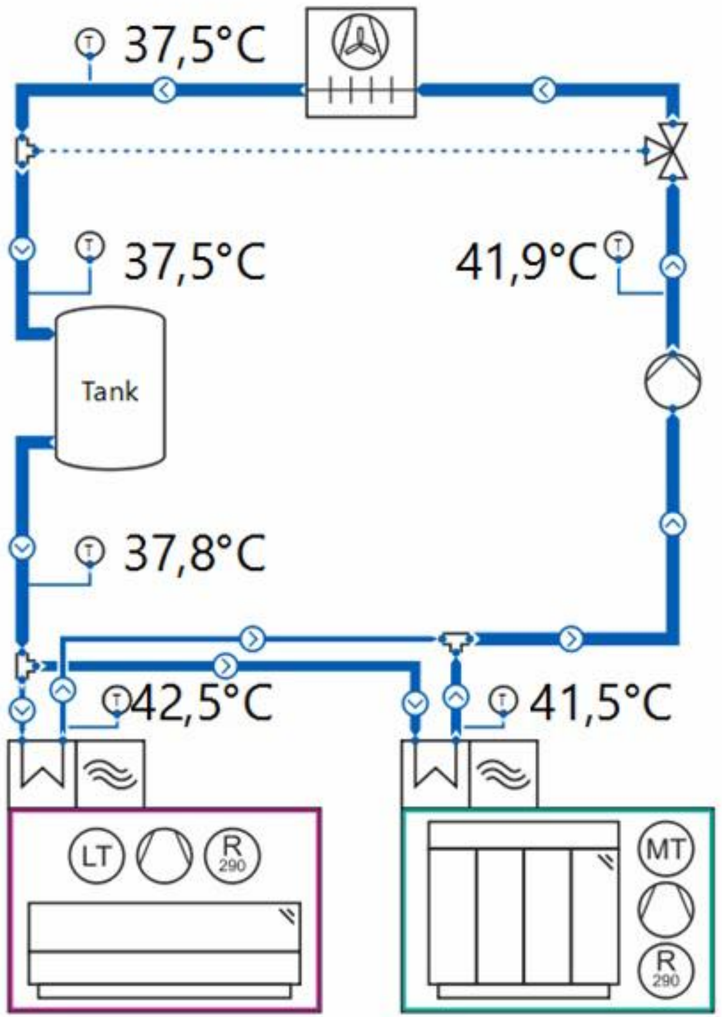

$> 35°C$

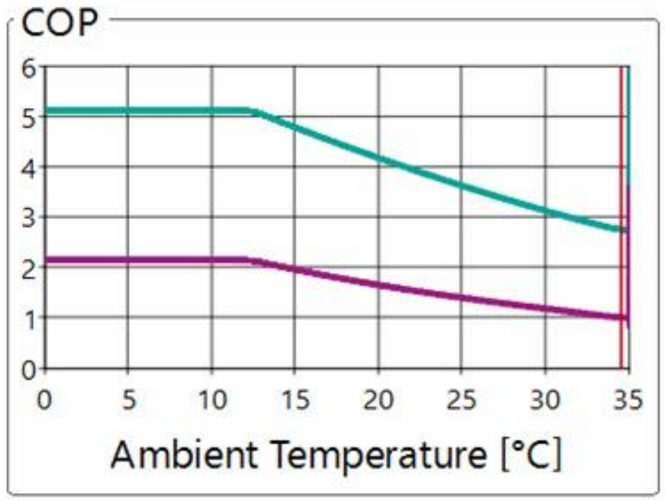
**Problem:**
Fluid temperature too high for LT-cabinet

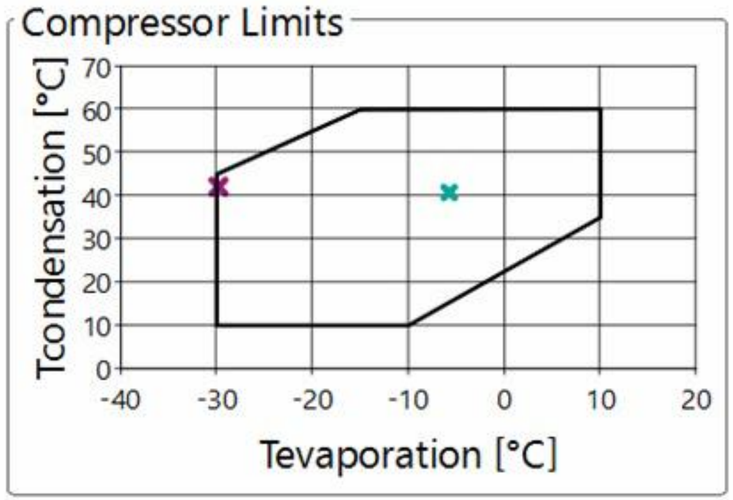
**Solution:**
Adding a Chiller



# Simulation of Different Ambient Temperatures

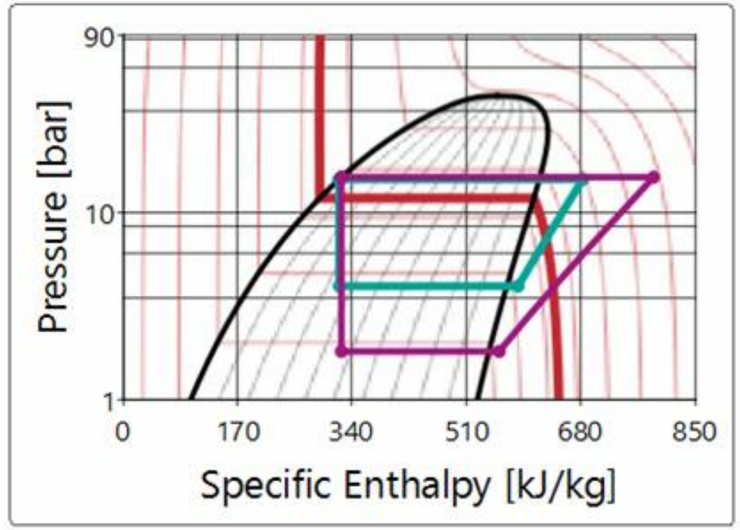


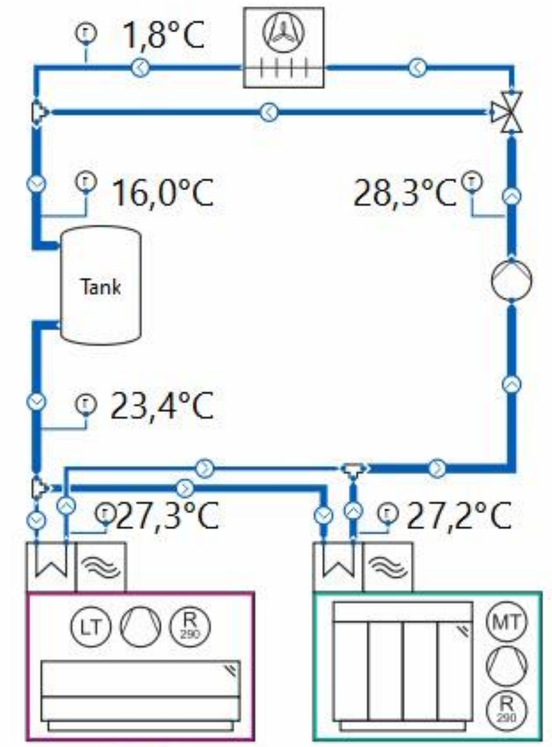



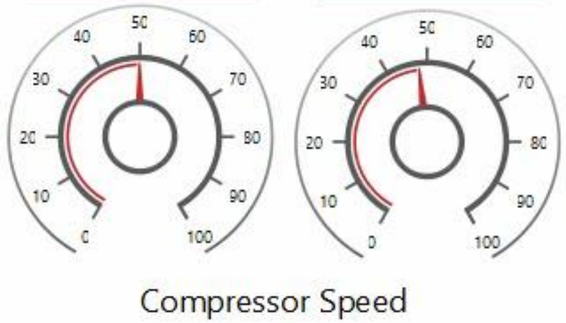

34,5 °C

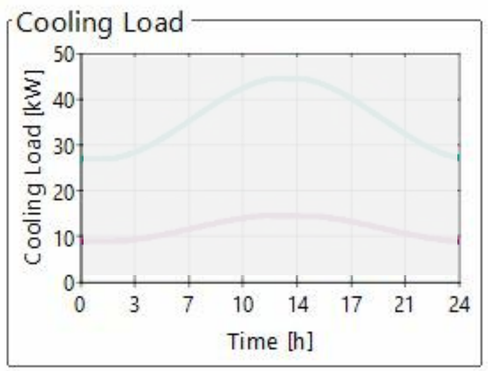
| | LT | MT |
|---|---|---|
| Qflow | 15,0 kW | 45,0 kW |
| $P_{electric}$ | 14,7 kW | 16,3 kW |
| COP | 1,0 | 2,8 |

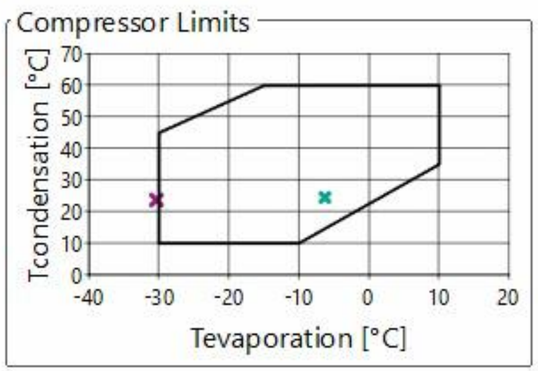


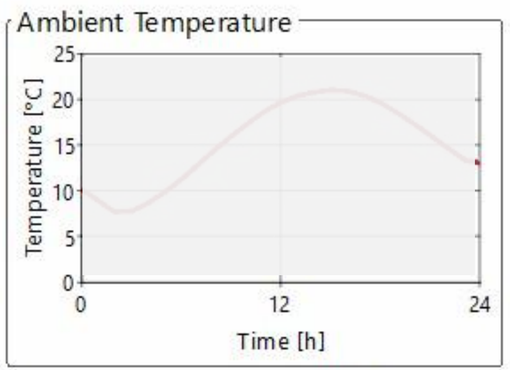
# Simulation of Entire Year

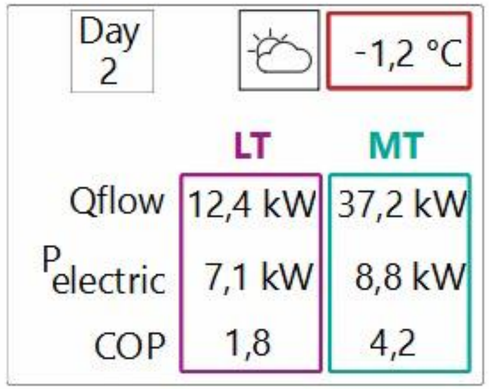


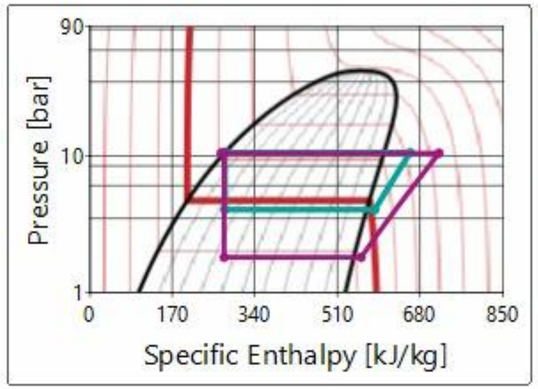



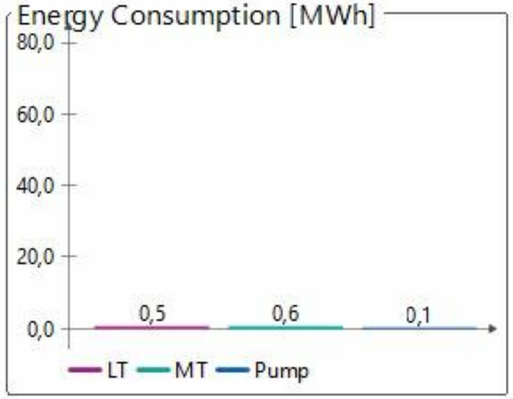



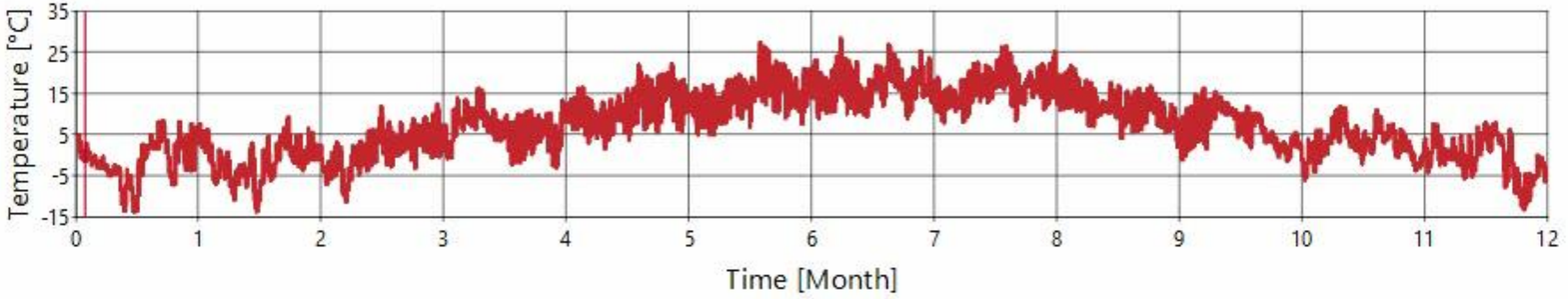



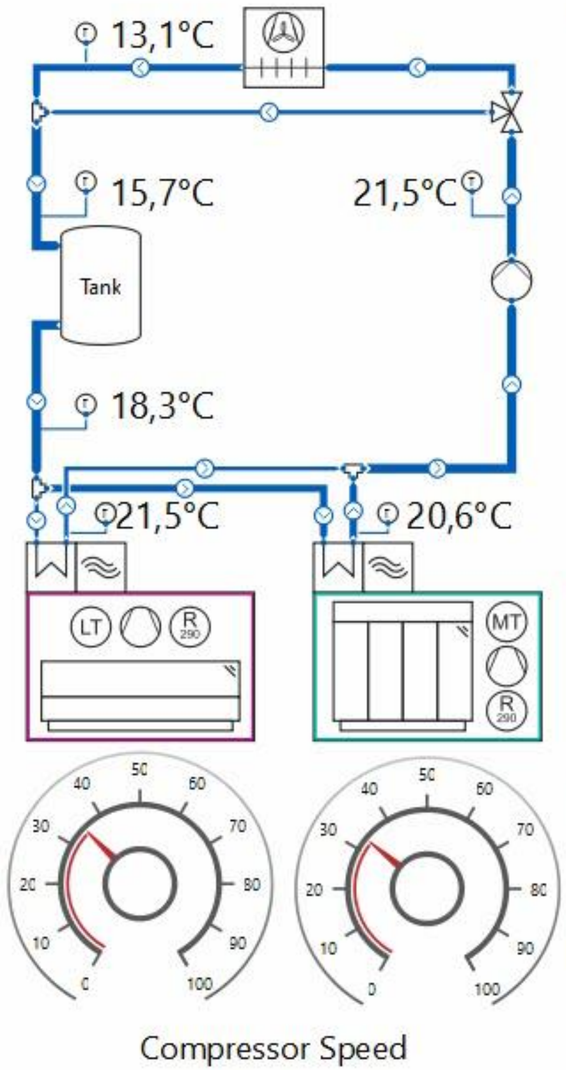



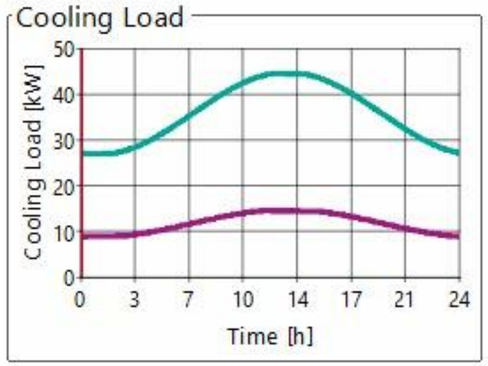



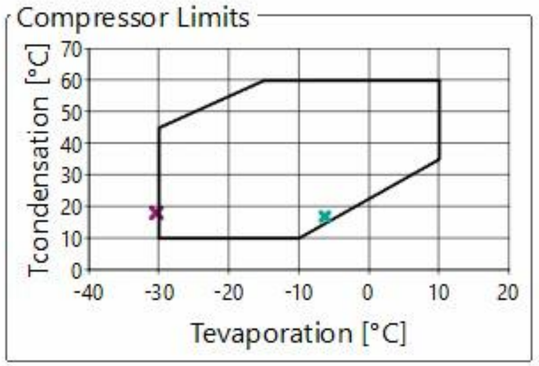



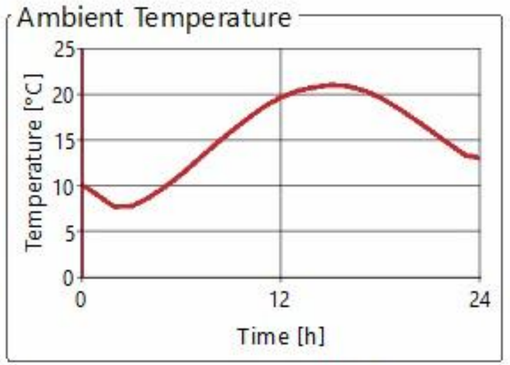



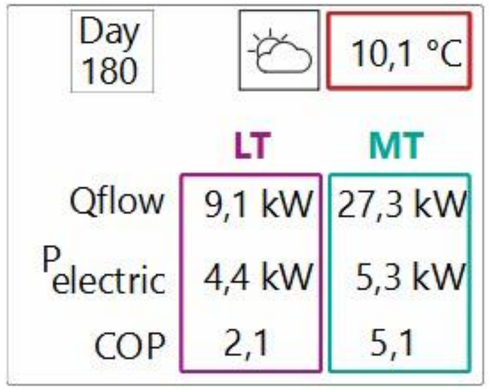
# Simulation of Entire Year: One Day

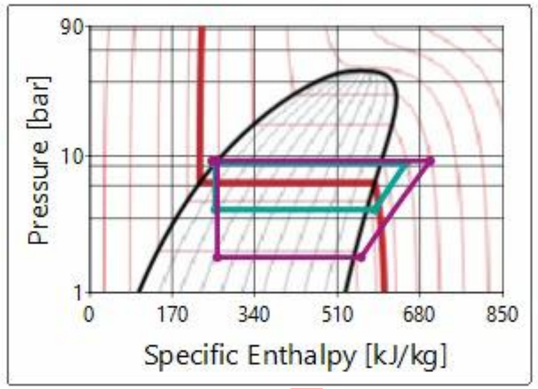


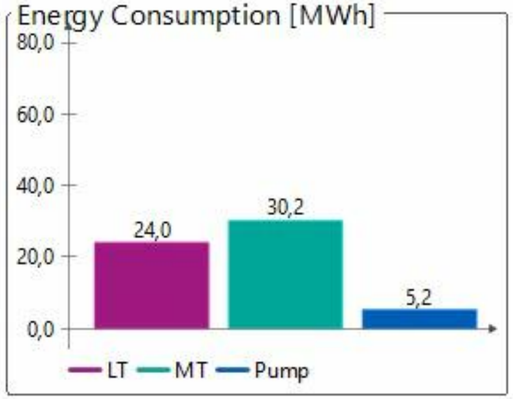



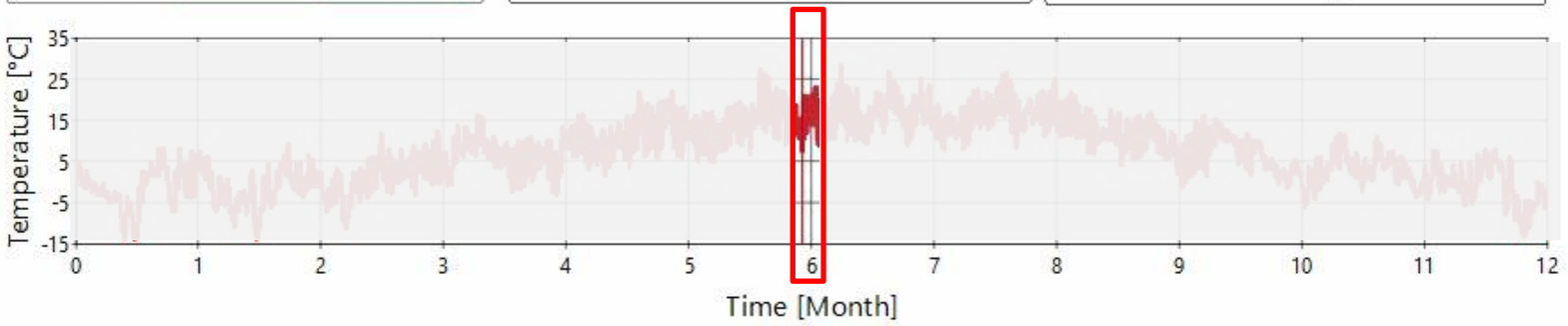



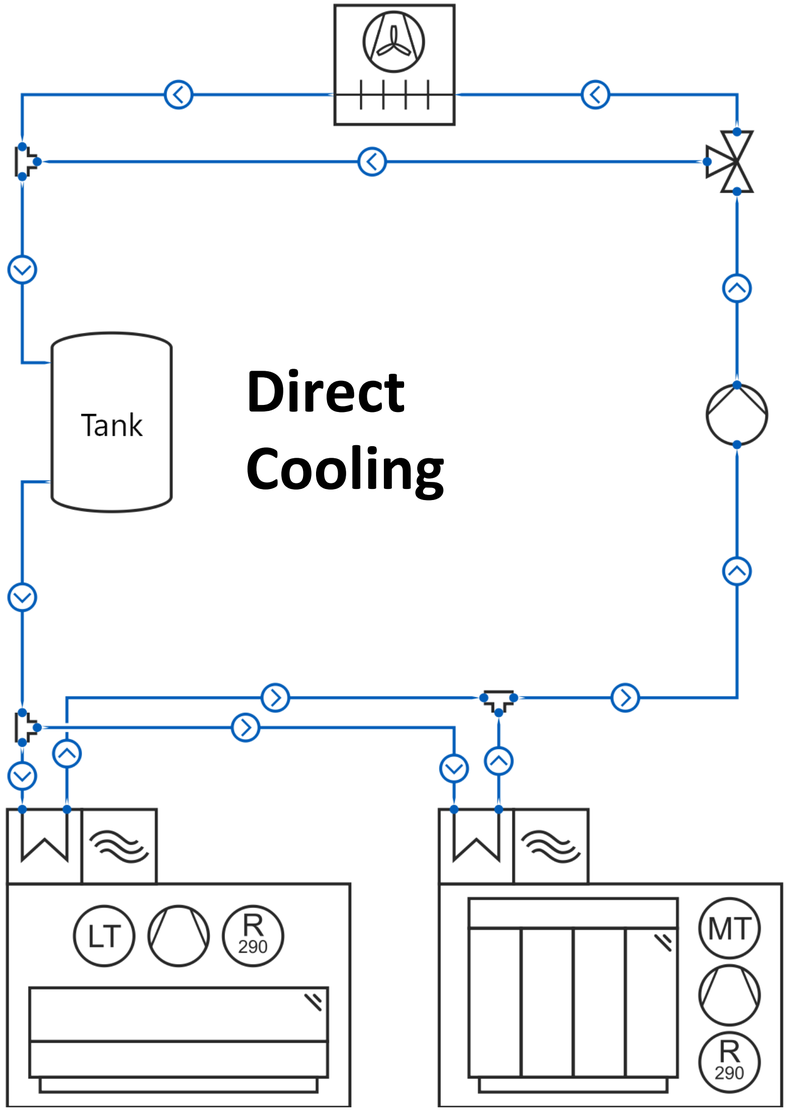



# Case Study Scenarios

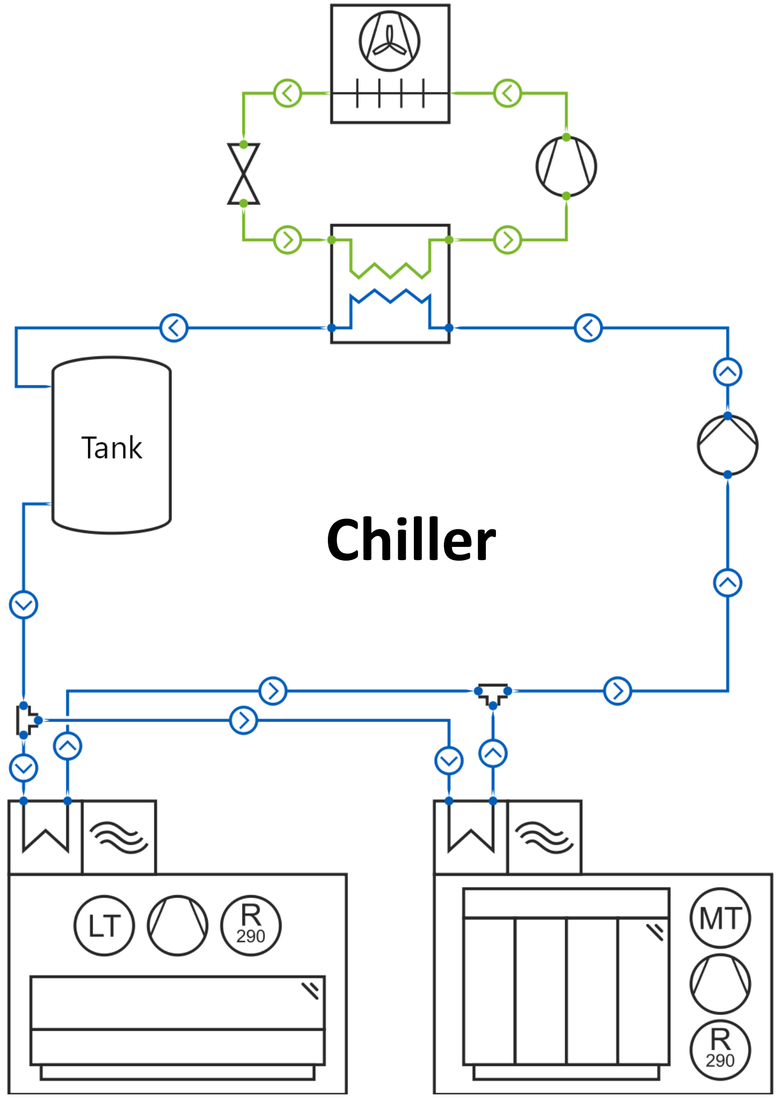



**Locations:**

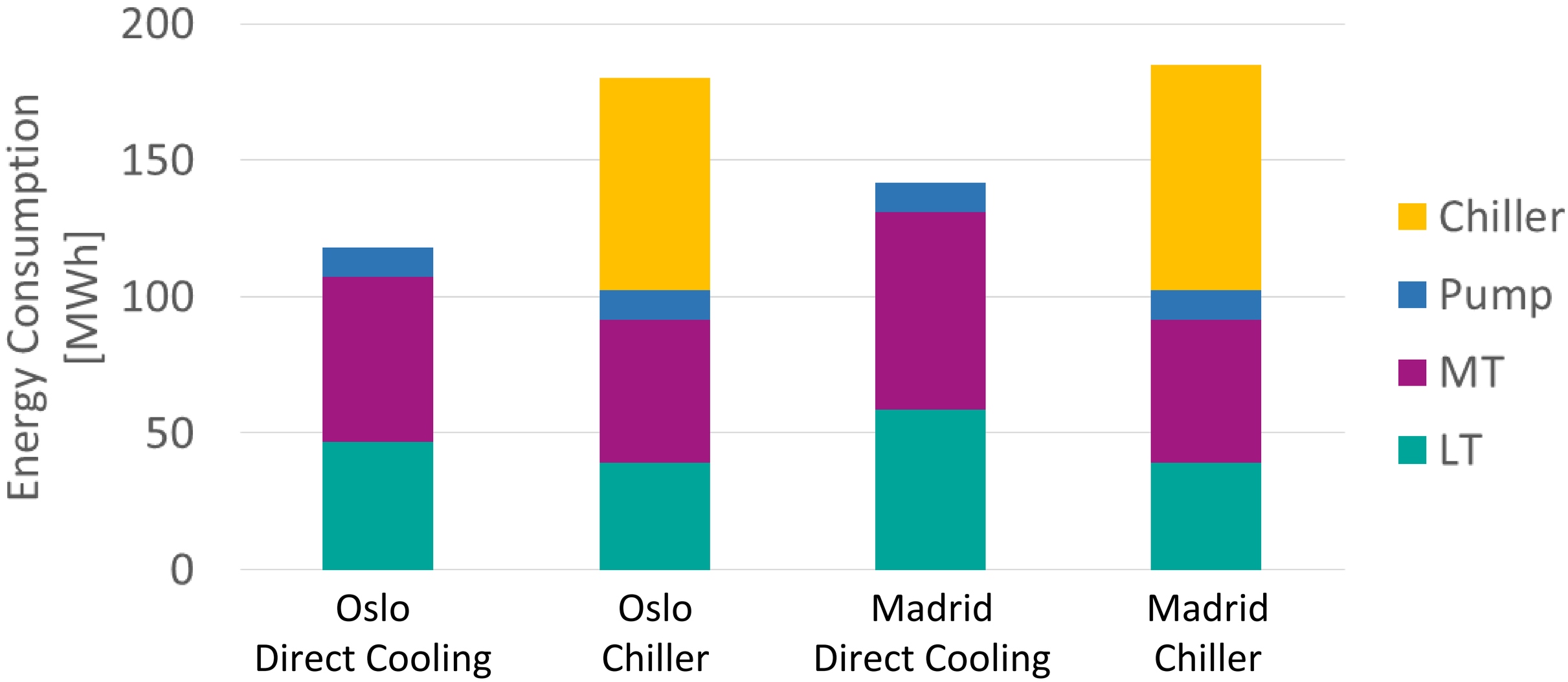
1. Oslo
2. Madrid

**Systems:**

1. Direct Cooling
2. Chiller



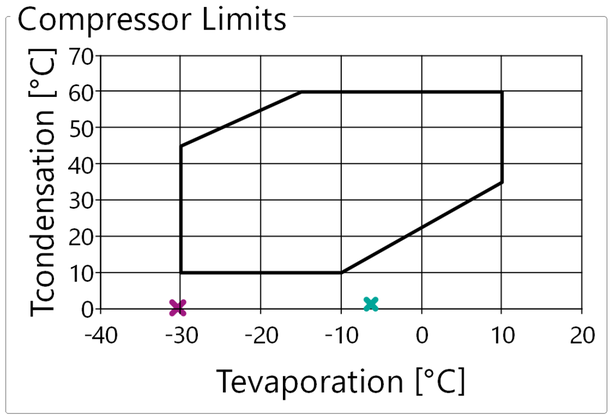
# Results: Annual Energy Consumption



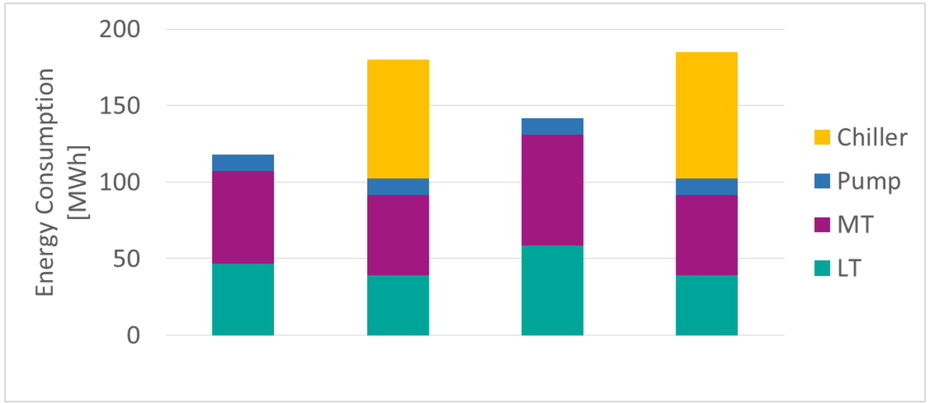
# Summary

**Advanced Simulations:**

- **New system layout** can be **built up easily**
- **In-depth analysis** and
- Simulation of **entire years** are possible




➢ Low pressure ratio for compressors required




➢ No energetic benefit of chillers

# SuperSmart Project

**Objectives:**

- Remove non-technological barriers
- Increase market uptake of efficient heating and cooling technology

**Activities:**

- Trainings at conferences
- Preparation of EU Ecolabel for food retail stores

**Your Benefits:**

➢ Free of charge trainings at your premises

➢ High quality reports available for free

- **Horizon 2020** Program
- Start: 1.2.2016
- Duration: 36 months
- **9 project partners** from all over Europe
- 8 **reports** about **efficient food retail stores** available

# Thank you!

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www.supersmart-supermarket.info

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