

CIPEA Innovation Day

CERN Clean Cooling and Heating

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<https://indi.to/bmDNV>



Proposal: CERN Clean Cooling and Heating coupled with thermal energy storage

- Replace current chillers by **clean long-term solutions**
- Develop a **clean cooling/heating cluster based** on CO₂ for CERN and surrounding infrastructure
- Demonstrate innovative and economic solutions to reduce demand for primary energy (**reduction of energy bill and peak demand**)

**TOWARDS A SUSTAINABLE
MANAGEMENT OF RESOURCES**

Current CERN Cooling and Heating Infrastructure

Some CERN Yearly numbers:

- Chillers : ~100 units and 85 000 kW
- Heat rejected to water*: 224 000 kWh
- Heat provided by fuel boilers**: 60 000 kWh
- Cooling water consumption***: 2 000 million liters
- Energy demand: 1 200 000 MWh

*“Nothing is lost, nothing is created,
everything is transformed”*

Antoine Lavoisier

* Value based on EN-CV 2019 Report on power dissipated in water cooling towers

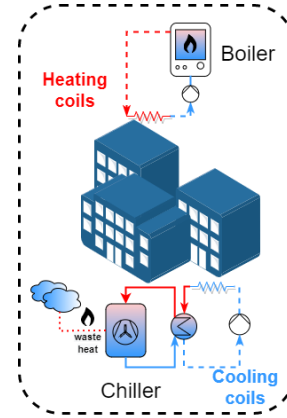
** Rough estimate for Meyrin + Preveessin sites. Replacement for heat pumps under studies

*** Value based on EN-CV 2019 Report on Water Consumption. Water mostly lost by evaporation on cooling towers.

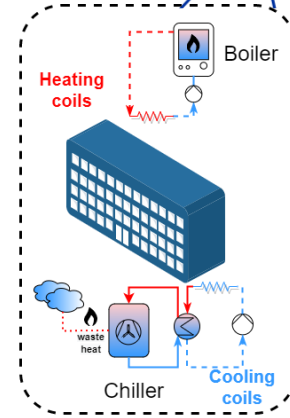
Project Roadmap

2022-2023

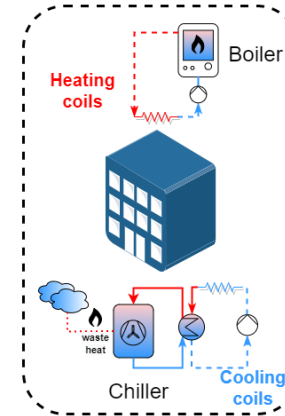
- Dedicated fuel boilers and chillers with pumped water circuits



Case 1



Case 2



Case 3

Project Roadmap

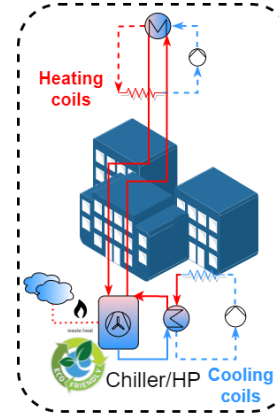
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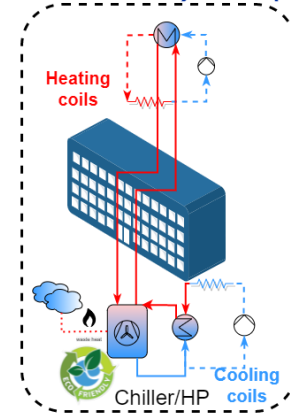
2023-2024: *Reduce energy demand and greenhouse gas emissions*

- Replace current chillers by clean alternatives (natural refrigerants) providing useful surplus heat
- Replace electrical heaters and fuel fired boilers by heat pumps (reversed chillers) providing useful surplus cooling*

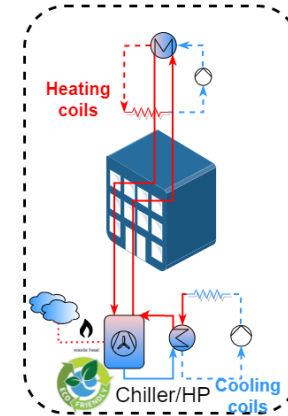
* Replacement of fuel boilers currently under studies



Case 1



Case 2



Case 3

Project Roadmap

2022-2023

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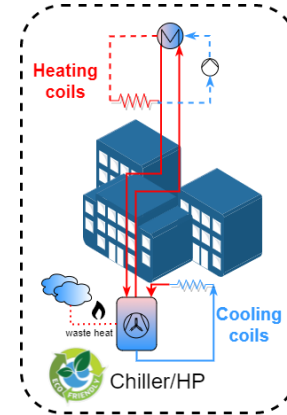
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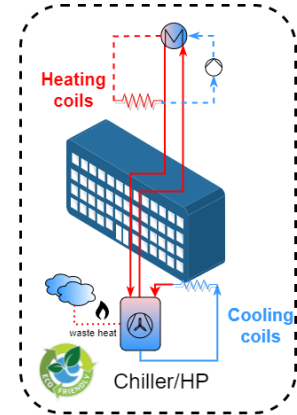
2024-2025: *Reduce energy and water demand*

- Demonstrate innovative Direct Expansion distribution network

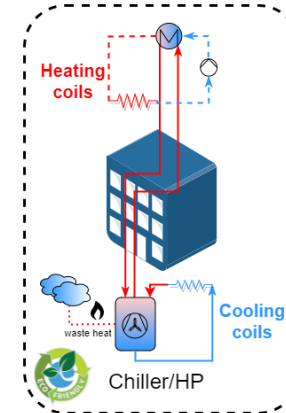
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Case 1



Case 2



Case 3

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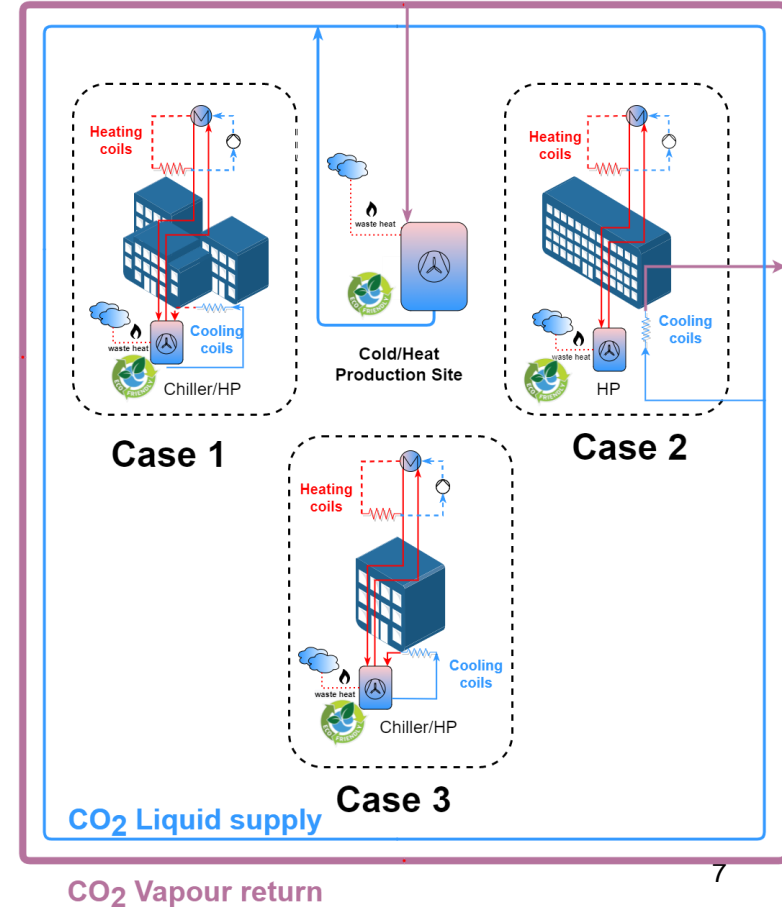
2024-2025: *Reduce energy and water demand*

- Demonstrate innovative Direct Expansion distribution network

2025-2026: *Reduce energy demand and waste heat*

- Centralized cold/heating production site with cooling network based on distributed CO₂

* Replacement of fuel boilers currently under studies



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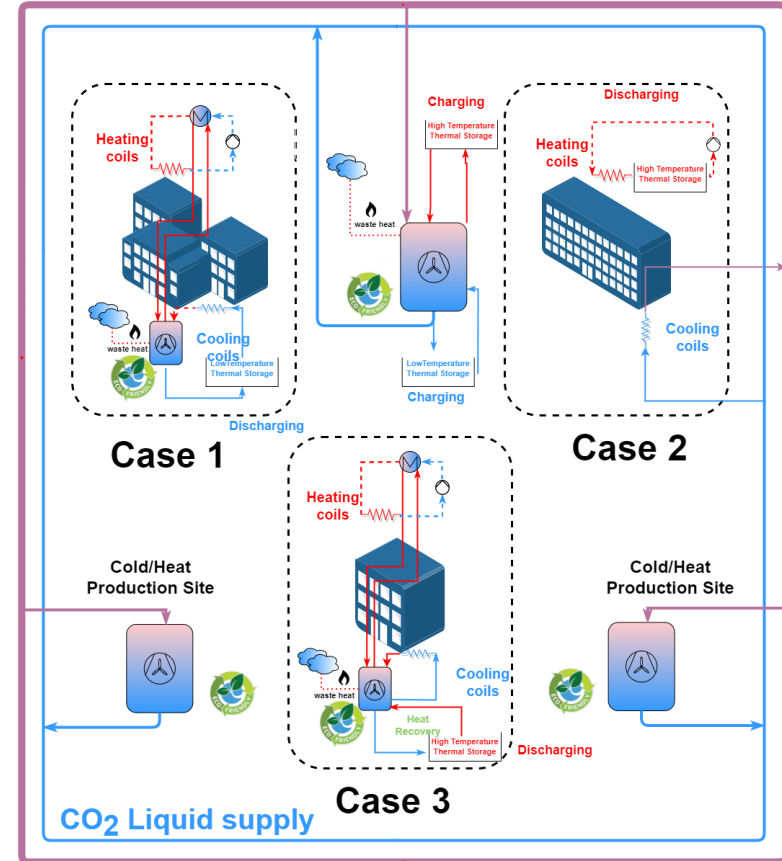
- Demonstrate innovative Direct Expansion distribution network

2025-2026: *Reduce energy demand and waste heat*

- Centralized cold/heat production site with cooling network based on distributed CO₂

2026-2027: *Reduce energy demand and smart utilization of cold and heat surplus*

- Distributed cold/heat production sites
- Modular thermal energy storage units



Beyond CERN



Preliminary discussions with:



*Norwegian equipment
manufacturer*



Integration



Norwegian University of
Science and Technology

Design studies and simulation

Workshop to gather other potential partners planned for Q4 2022:
(examples below)

- Hotels in the Grand Geneva for utilization of waste heat
- Heat Exchanger manufacturers
- District Heating and Cooling Services



Summary

CERN and environmental benefits:

- Reduction of **energy and water consumption**
- Reduction of **waste heat**
- Reduction of installed cooling capacity and water pumping systems

Technological innovation opportunities:

- CO₂ DX Evaporators in HVAC systems
- On-demand cooling capacity control strategies
- Smart management of distributed cold production sites and charging/discharging of thermal storage units
- Plug&Play modular thermal energy storage containers

Local partners:

- CERN Infrastructure can provide **Heat and Cooling as a service** for interested local users

**Thank you
questions?**

