Proposal for a new HPT TCP Project

CLImate-friendly COmfort cooling with focus on NATural refrigerants

CliCo-Nat

Serena Danesi, zhaw IEFE, Switzerland

Who we are

Energy Systems and Refrigeration Technology

Focus

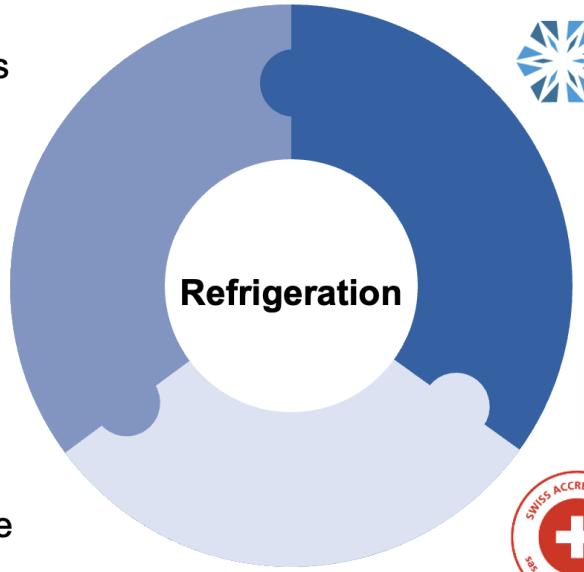
School of Engineering
IEFE Institute of Energy System and Fluid Engineering

Prof. Dr. Frank Tillenkamp
Head of Refrigeration Research
frank.tillenkamp@zhaw.ch

1 Simulations and evaluation methods
- Refrigeration circuit calculations and simulations
- Seasonal efficiency assessments
- Research and industry projects

2 Investigations in the laboratory
- Experimental investigations for R&D
- Validation of simulations
- Training and further education

3 Investigations in the field
- Mobile performance measurement (non-invasive measurements)
- Operational optimisation based on monitoring data
- Database with field measurements



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Kältemaschinen und Wärmepumpentechnik Kompetenzzentrum Winterthur

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SNV
standards connect the world

TC 113,182, 228, 44

TC 86

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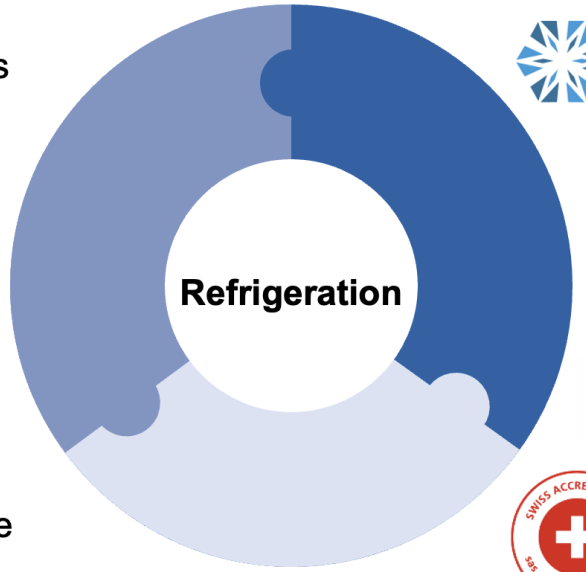

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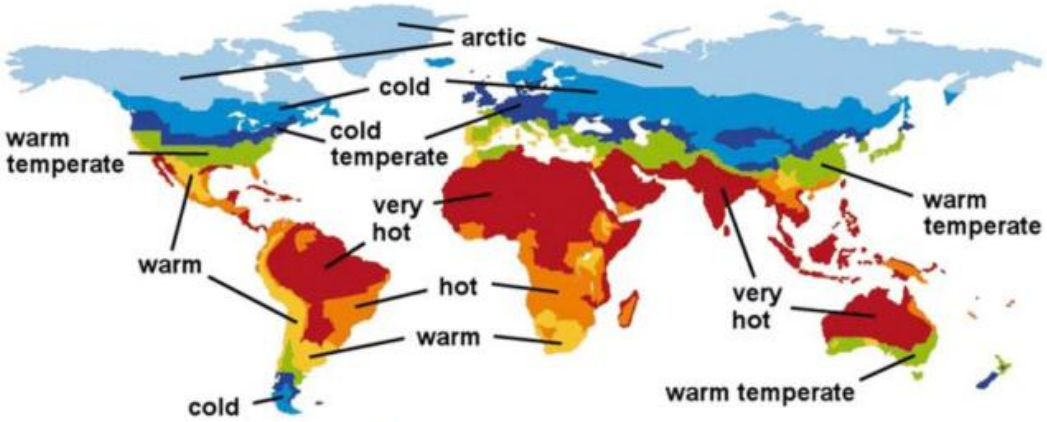
Background

Why comfort cooling, why now

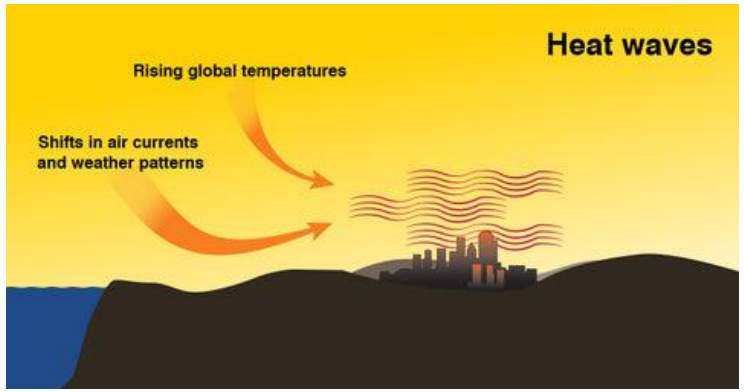
- **Cooling demand is rising fast:** in some regions up to half of the electricity demand on hot days
- **Heat waves** turn cooling into a standard need also in Europe and North America, in buildings designed for heating only
- **Window of opportunity:** heat pumps installed today will still run in 15–20 years
- **Refrigerant transition:** F-gas Regulation, PFAS/TFA concerns → **natural refrigerants** (R290, R744, R717)
- Best solution = **application-specific combination** of refrigerant, cycle, machine and distribution system

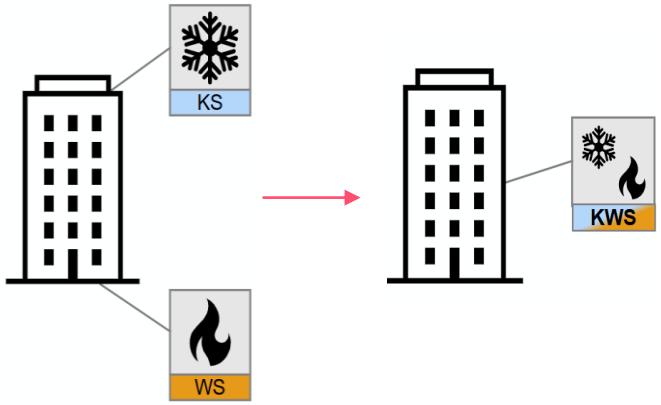


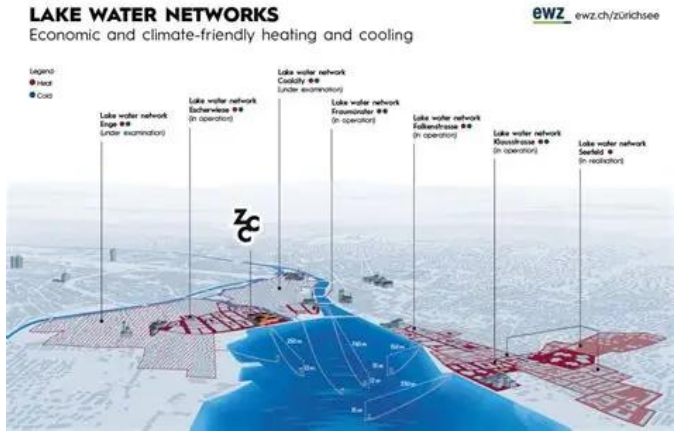
World-wide hot and humid climate

Central question

How can **heating-oriented buildings**, **heat pump systems and thermal infrastructures** be adapted to provide sustainable comfort cooling with natural refrigerants under changing climate conditions, while continuing to support heating decarbonisation?



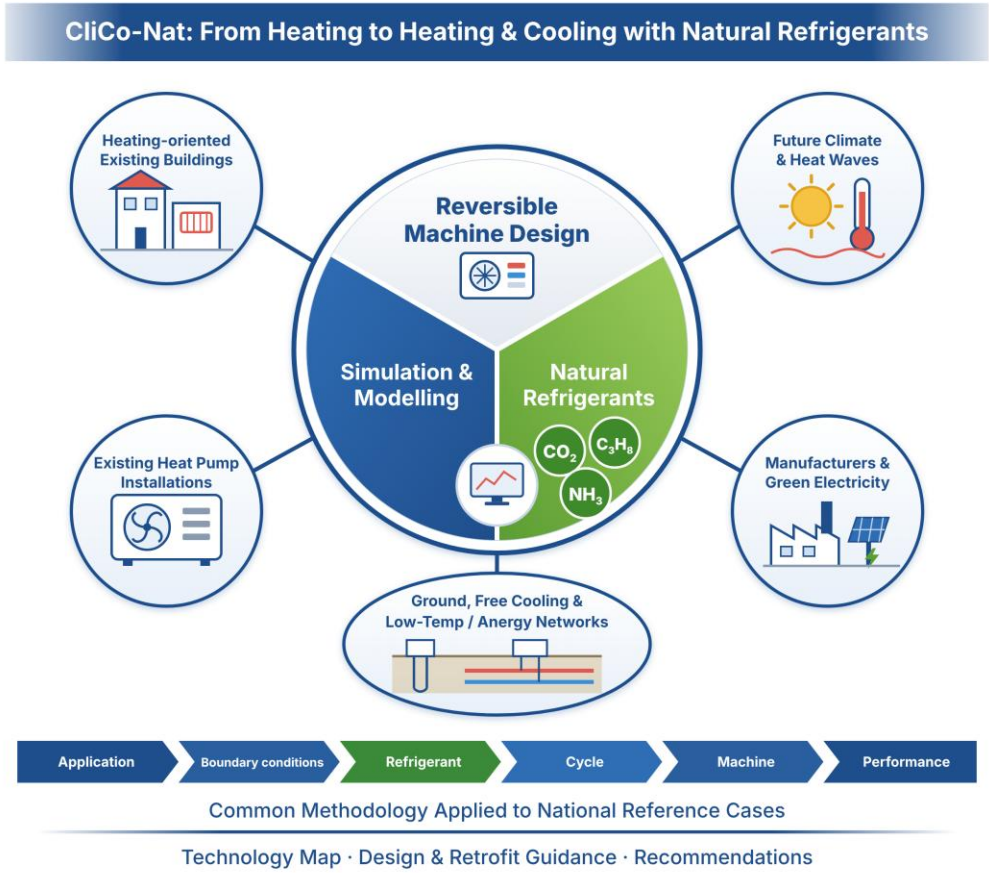




Our proposal

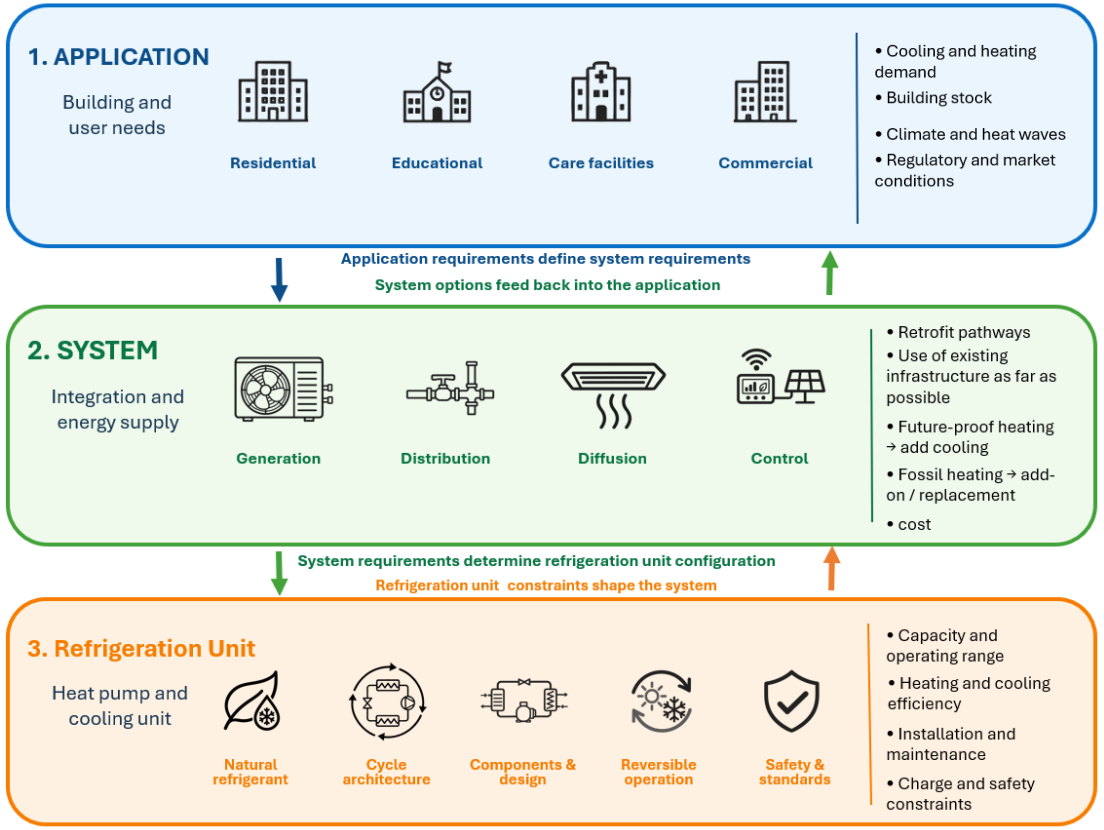
CliCo-Nat

- **Reversible units** with natural refrigerants: cooling in summer, high-temperature heating in winter
- **Simulation-based** assessment, complemented by field data and validation with manufacturers
- Assessment of **natural refrigerants** (CO_2, propane, ammonia) and advanced cycles
- Residential, educational, care and commercial buildings, **small to medium capacities**
- Result: **international technology map**, design and retrofit guidance



Methodology

Application – System – Refrigeration unit



Shared key performance indicators

- Thermal comfort
- Refrigerant charge
- Installation cost and effort
- Seasonal performance in cooling and heating
- Peak electricity demand

Heat sources and sinks

- Outdoor air, ground with free cooling, low-temperature and anergy networks

Objectives

Not isolated solutions -> representative case studies used to develop transferable and scalable CliCo-NAT results

Technical challenges

Technical barriers, safety requirements, component limitations, control strategies and integration challenges

Regulatory aspects

Safety standards, refrigerant regulations and building codes

Stakeholder involvement

Identification of stakeholders as manufacturers, planners, utilities, building owners and policy makers

Geographical and climatic relevance

Evaluation of the climatic conditions and geographical regions where each solution is most relevant

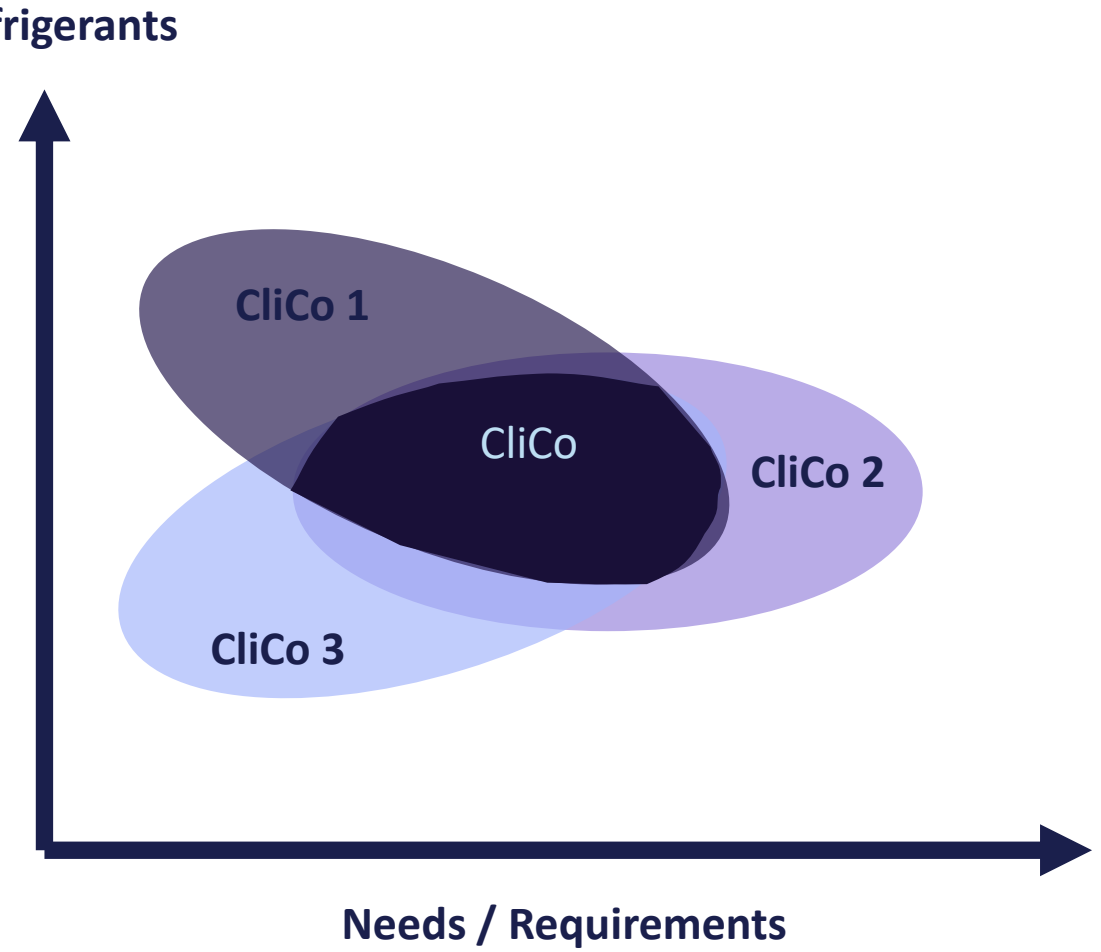
Green electricity connection and compensation mechanisms

Physical connection to renewable electricity sources as well as compensation by Certificates

Acceleration and support for market uptake of **natural refrigerants towards sustainable comfort cooling.**

Outcomes

- Development of **standardized** Climate friendly Cooling Units
- **Regional** adaption and integration
- Market readiness and **knowledge dissemination**
- **Business Models, Cost reduction** & economies of scales
- Contribution to **UN-SDG**



Target Audience, Benefits

Manufacturers

validated design principles for reversible natural-refrigerant products

Planners

technology map, reference cases, retrofit guidance

Building owners

how existing buildings can be cooled with heat pumps

Policy makers

decision basis for deployment programmes, avoiding heat pumps that cannot cool

Utilities

coupling to low-temperature networks, ground and renewable electricity

Society

PFAS-free refrigerants, higher efficiency, comfort during heat waves

Deliverables

- **Technology map** of best-fit refrigerant–cycle–machine configurations
- **Design and retrofit guidance** for planners and manufacturers
- **Recommendations** for heat pump deployment programmes
- **Reference cases, models and data** for research
- **Dissemination:** final report, project website, HPT Newsletter, joint workshop, final webinar

Interest and Participation

Contracting Parties (confirmed or strong interest)

- ✓ Switzerland, ZHAW
- ✓ Germany: Fraunhofer
- ✓ Italy: Gandini srl
- ✓ USA: University of Maryland (as expert)

Preliminary interest

- ➢ France: Cetia
- ➢ Belgium: European Environmental Bureau
- ➢ Denmark: Danish Technological Institute
- ➢ Switzerland, OST

Strategic Partners and Countries to Involve

- ○ Austria, AIT
- ○ Sweden, KTH
- ○ Spain, University of Valencia
- ○ India, Japan, South Korea, Singapore (?)

Wanted

- ○ More countries with different climates
- ○ Heat pump and cooling unit manufacturers

Participation is open after approval of the Annex

CliCo-NAT & HPT TCP RDD&D Priorities

1 System Integration

- High supply temperatures for existing heating systems in winter, efficient cooling in summer
- Hydraulic integration into existing distribution (radiators, floor heating, fan coils)
- Coupling energy sources, storages and green electricity

CliCo-NAT contribution: *Modular units that plug into existing building systems and local thermal networks*

2 Robust, Sustainable and Affordable Value Chains

- Standardized modular architectures
- Less planning and installation effort in existing buildings
- Regulatory aspects for different applications as flammable refrigerants in buildings not designed for cooling

CliCo-NAT contribution: *Reduces complexity and supports economies of scale for natural refrigerants*

3 Extending Operating Range and Applications

- Retrofit and new applications adding cooling with a single unit
- High-temperature heating in winter, cooling during heat waves
- Buildings not designed for cooling: space, acoustic and safety constraints

CliCo-NAT contribution: *Expands natural refrigerant cooling solutions to diverse climates and building types*

4 Refrigerants and New Technologies

- Natural refrigerants
- Advanced cycles for reversible operation over large lifts (e.g. ejectors, transcritical CO_2)
- New integrated units with heat recovery for retrofit

CliCo-NAT contribution: *Evaluation and optimization of natural refrigerants for future climate-friendly cooling systems.*

Building on HPT work, connected beyond it

Within HPT TCP

Annex 53 & 54
technology and refrigerant basis

Project 55
Comfort Climate Box: building simulation, optimisation

Project 60
retrofit methodologies, large non-domestic buildings

Project 63
acoustics of outdoor units

Project 64
flammable refrigerant safety, used as design constraints

Project 66
field data and best practice

Beyond HPT

DHC TCP
coupling units to low-temperature and anergy networks

Cities TCP Task 5 + EBC Annex 97
heat rejected by decentralised units in cities
★ **Concrete collaboration request**

EBC Annex 80
resilient cooling: building-side measures

THANK YOU FOR YOUR ATTENTION!

Serena Danesi
+41 (0) 58 934 49 90
serena.danesi@zhaw.ch
ZHAW School of Engineering
Technikumstrasse 9
8400 Winterthur