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Intelligent Hybrid Thermo-Chemical District Networks

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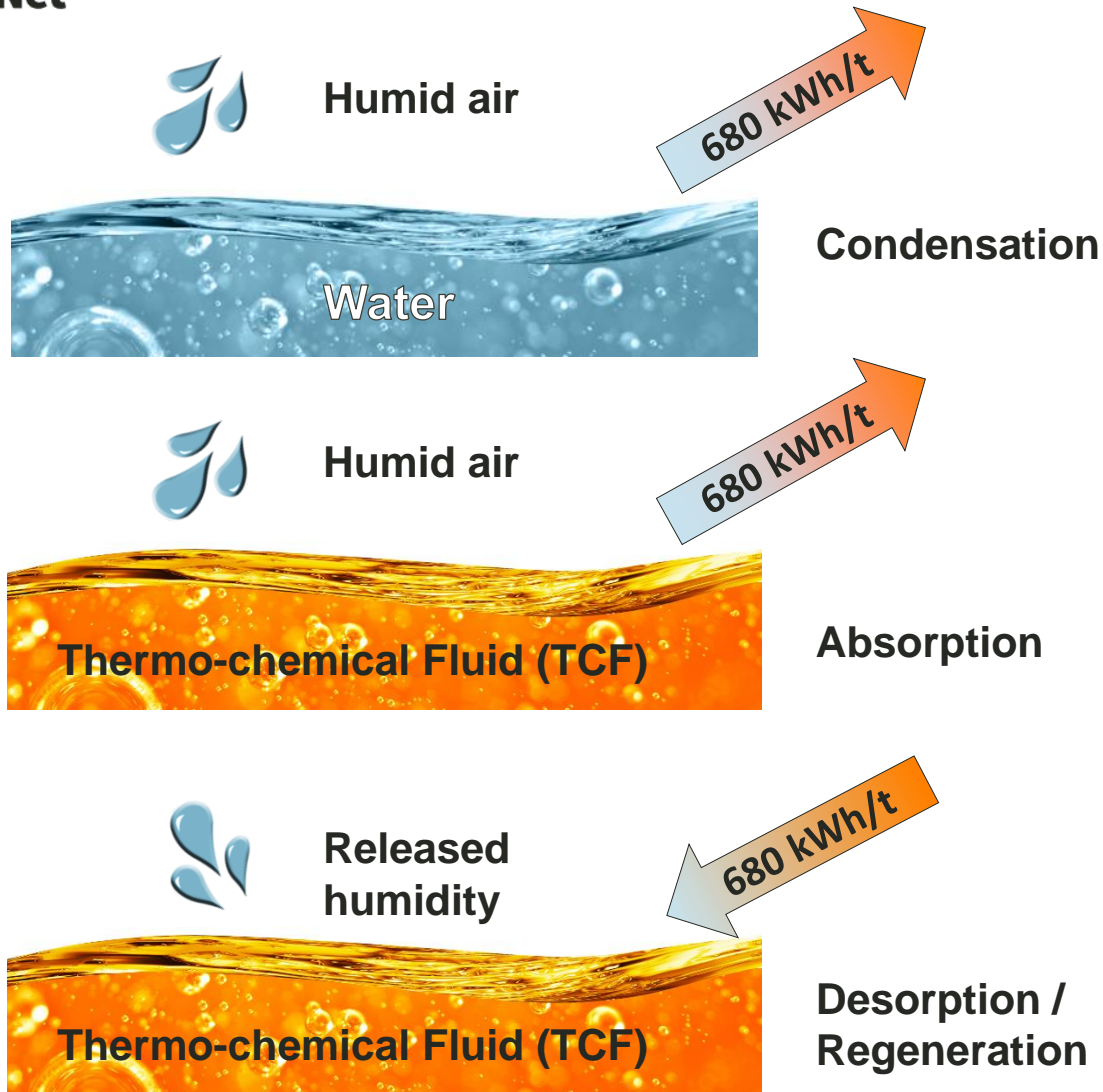
Smart Energy Systems and 4th Generation District Heating

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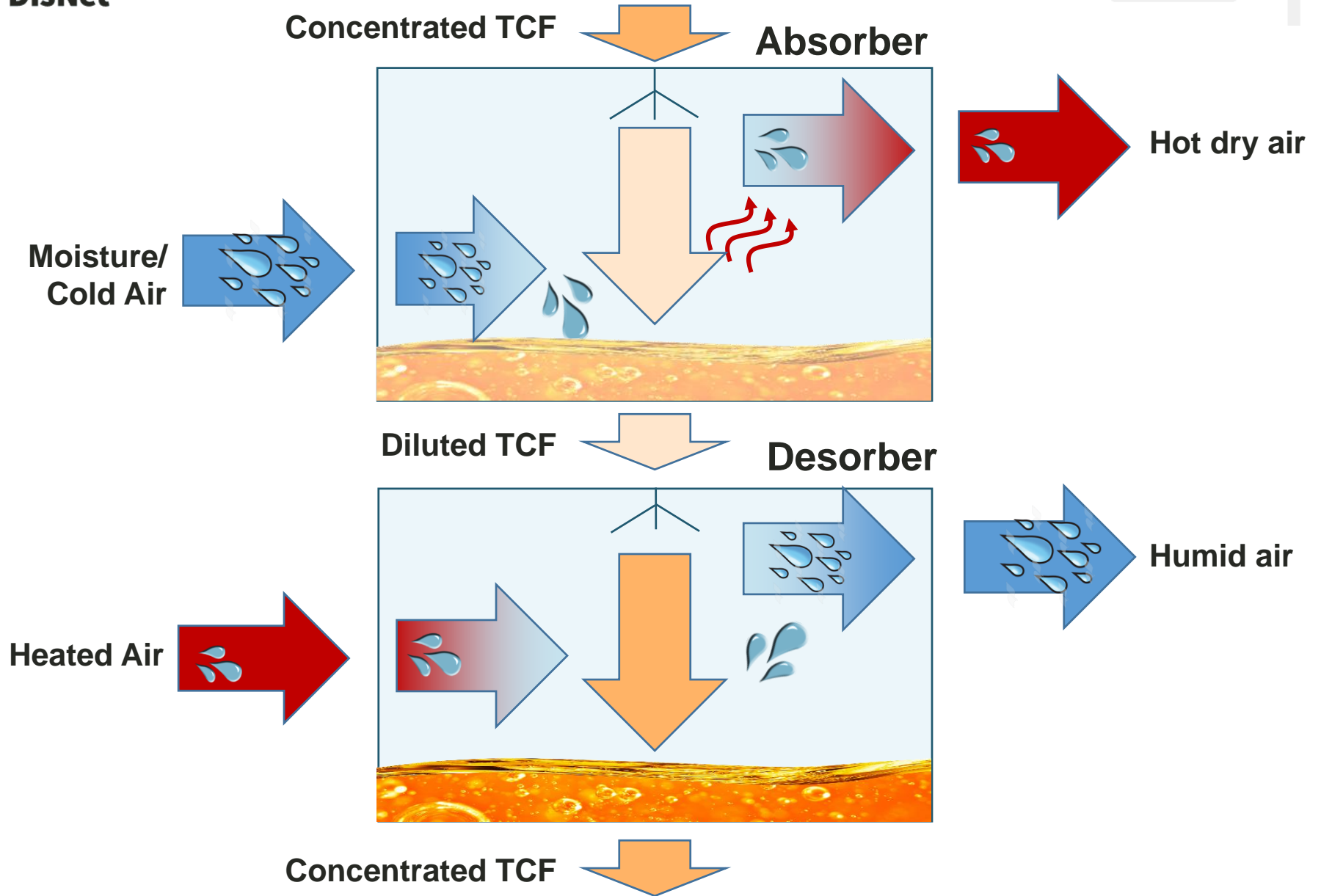
Thermo-chemical processes



Provide three services in a thermo-chemical network:

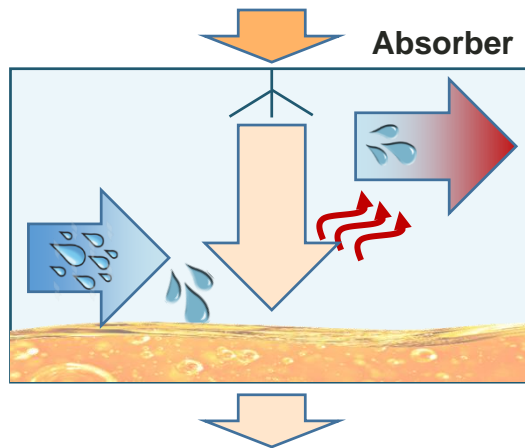
- «use case» Industrial drying
- «use case» Space heating
- «use case» Space cooling

Absorber/Desorber



- Absorption produces dry air
- Usable directly for drying
 - Reduction of primary energy consumption
- Humidity control by stabilization function of TCF

Drying goods



Heating and heat recovery

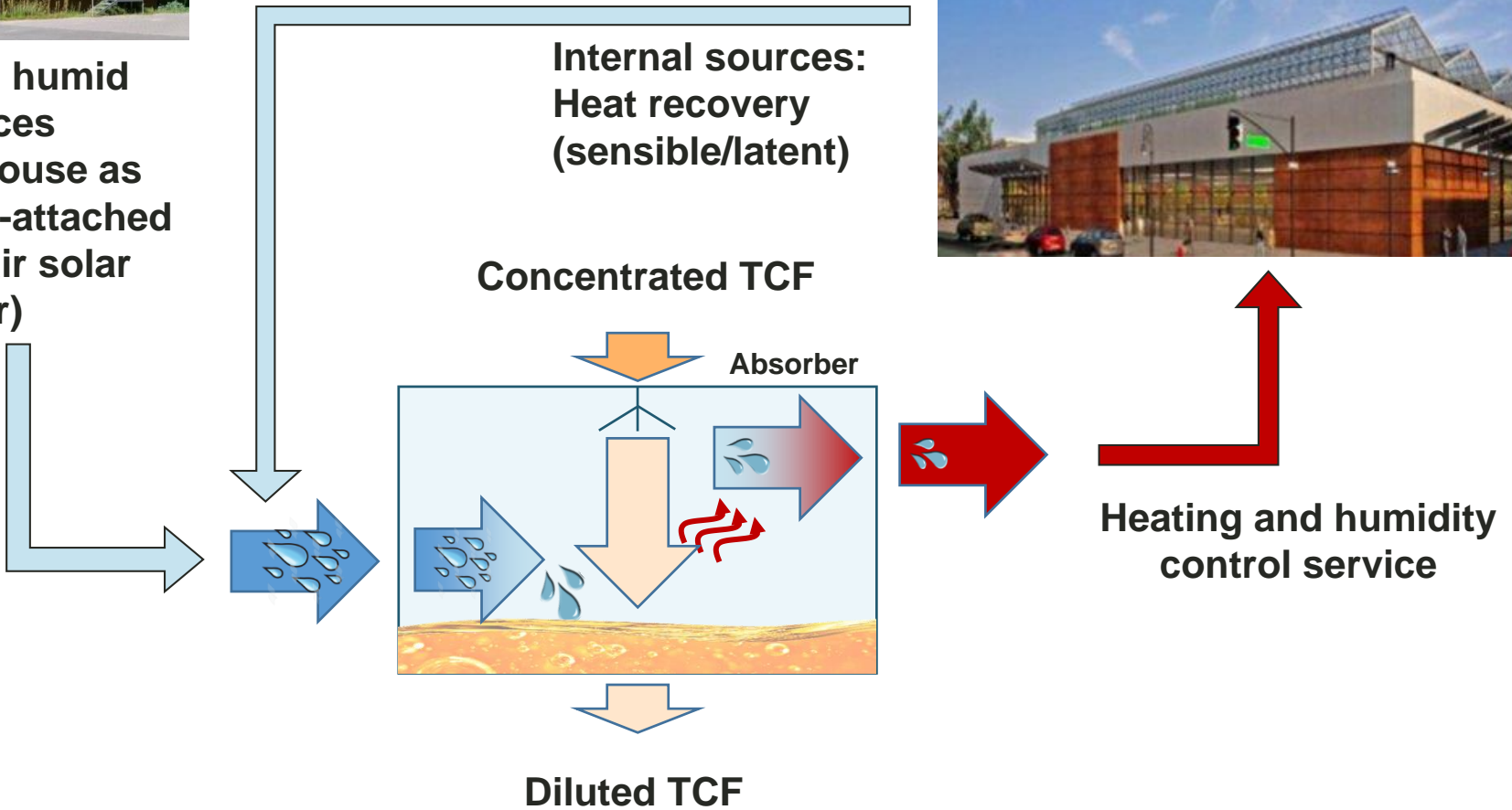
«use case»
Space heating



External humid air sources
(Greenhouse as building-attached Humid air solar collector)

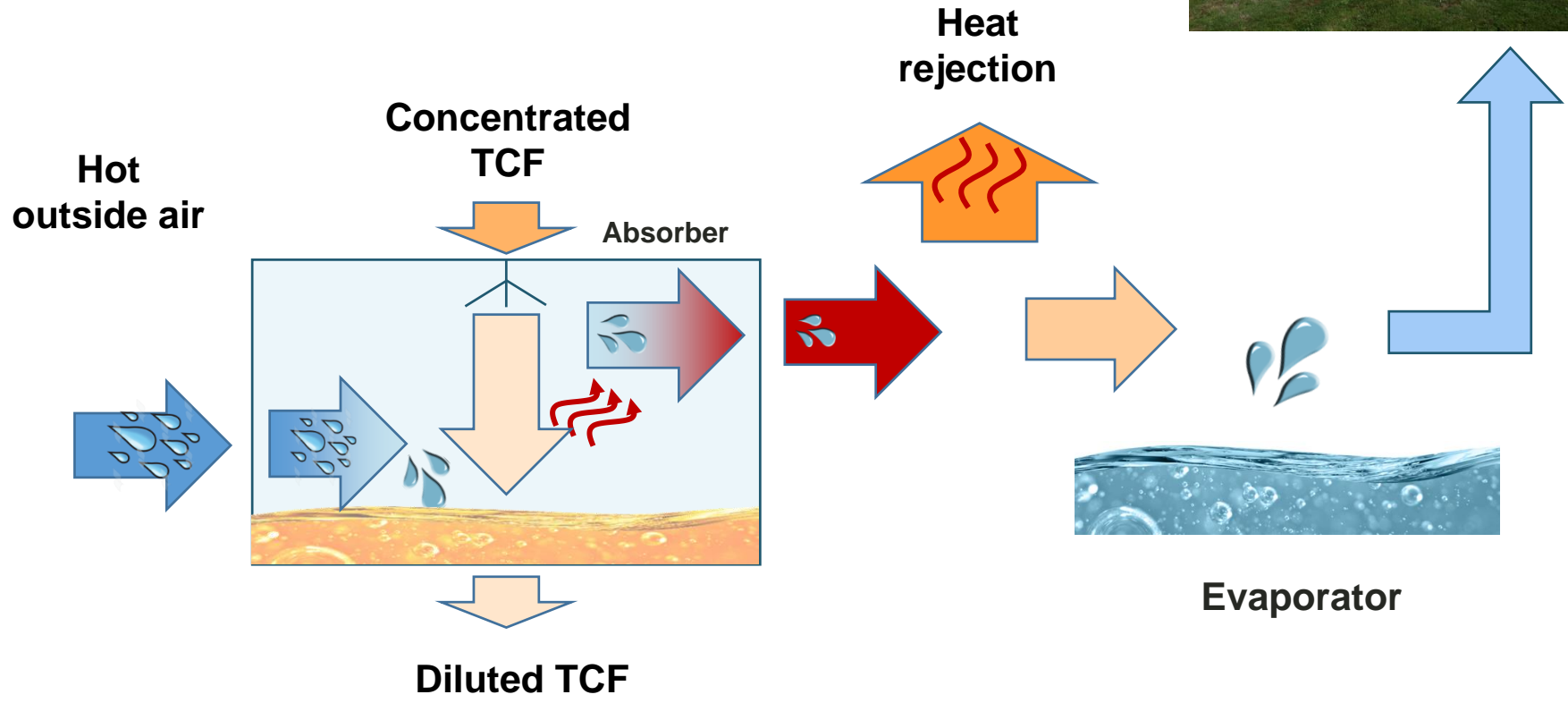


Heating demand



Space cooling

«use case»
Space cooling

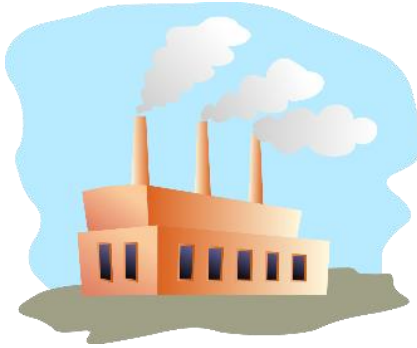




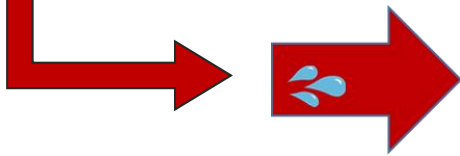
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Regeneration on supply-side

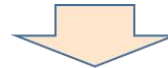
Heat Source/factory



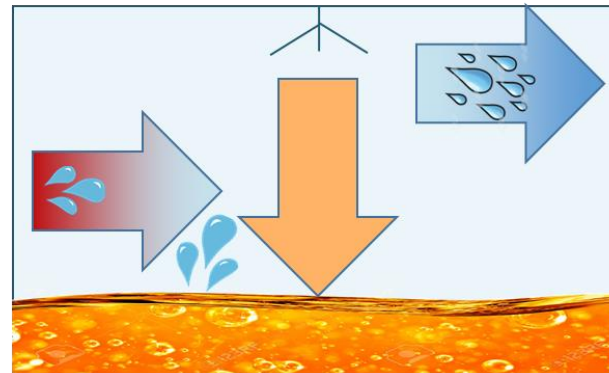
Low-temperature
excess heat
(30..60°C)



Diluted TCF



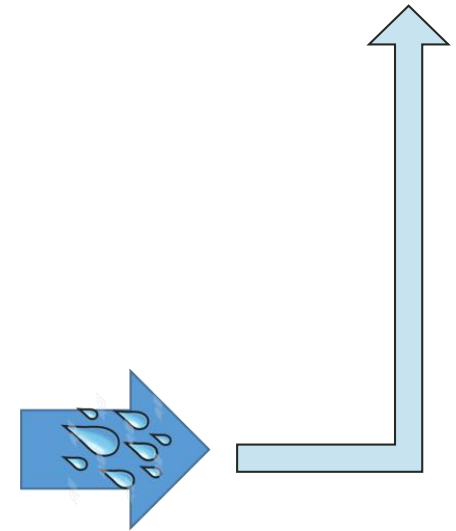
Desorber



Concentrated TCF

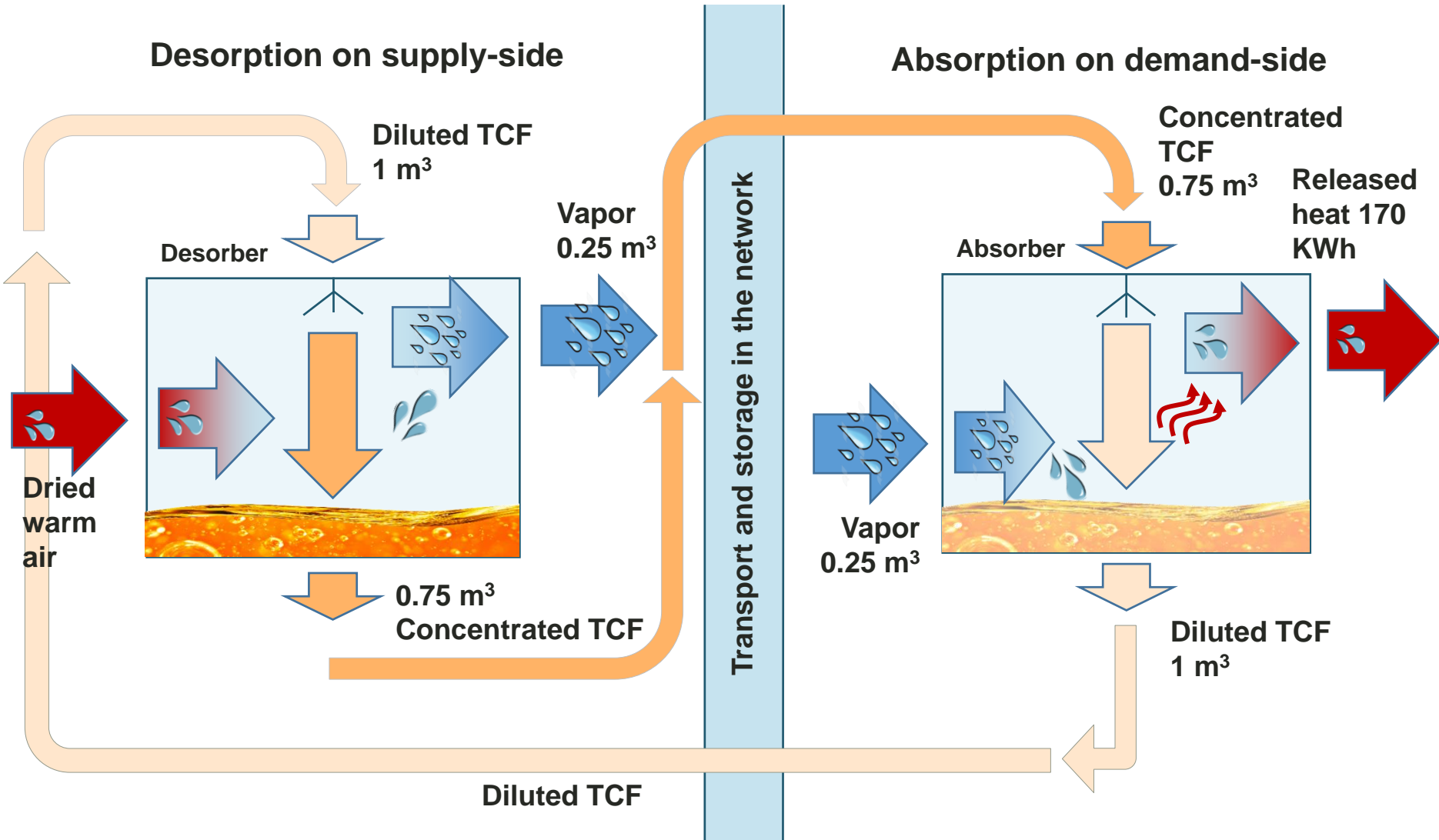


Environment





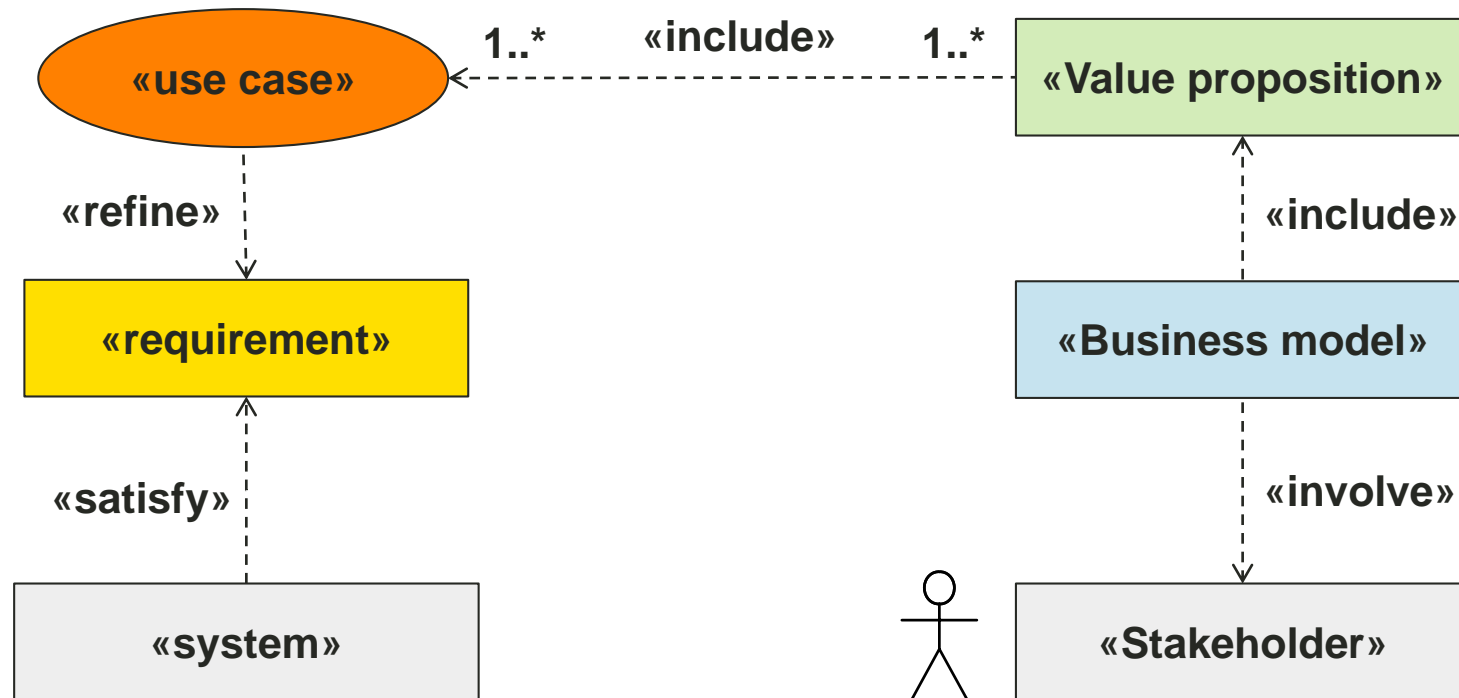
Thermo-chemical processes in a network



Use cases and value proposition

Technology application scenarios

Economic strategy





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District heating return flow

Problems/Challenges/Requirements

Pain reliever/Gain creator

Plan for CO₂ reduction • Local employment

Energy Provider

New clients & business (offer more than hot water) • ROI <5-10 years • Reduced heat demand • Need for improved PEF and for emission reduction Opex/Capex , Adding complexity, life-time, maintenance, use of heat from cooling tower

Combustion free technology • Reduction of losses and cost • Extension of network capacity • drying as new service •
Exploitation of cheap “green” low-grade heat
Better Opex/capex comp to trad solutions
Life-time security

H-DisNet solution designer
Compliance to local regulations; Proof of solution

Community

Combustion free technology; develop “green” jobs
Demonstrator 10-15 buildings

Building services

Demonstrator

«use case»
Use case 2: Humidity setpoint control

«use case»
Use Case 1: Humidity removal / Drying



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«use case»
UC 3: Space heating

«use case»
UC 4: Space cooling

School for contractors;

Users with residual heat

Higher efficiency; low heat price “green points”; humidity control

Cost of energy; CO₂ emission trading; prevention of humidity damage; green labelling

Users with high-humidity

Building Owners/ Investors

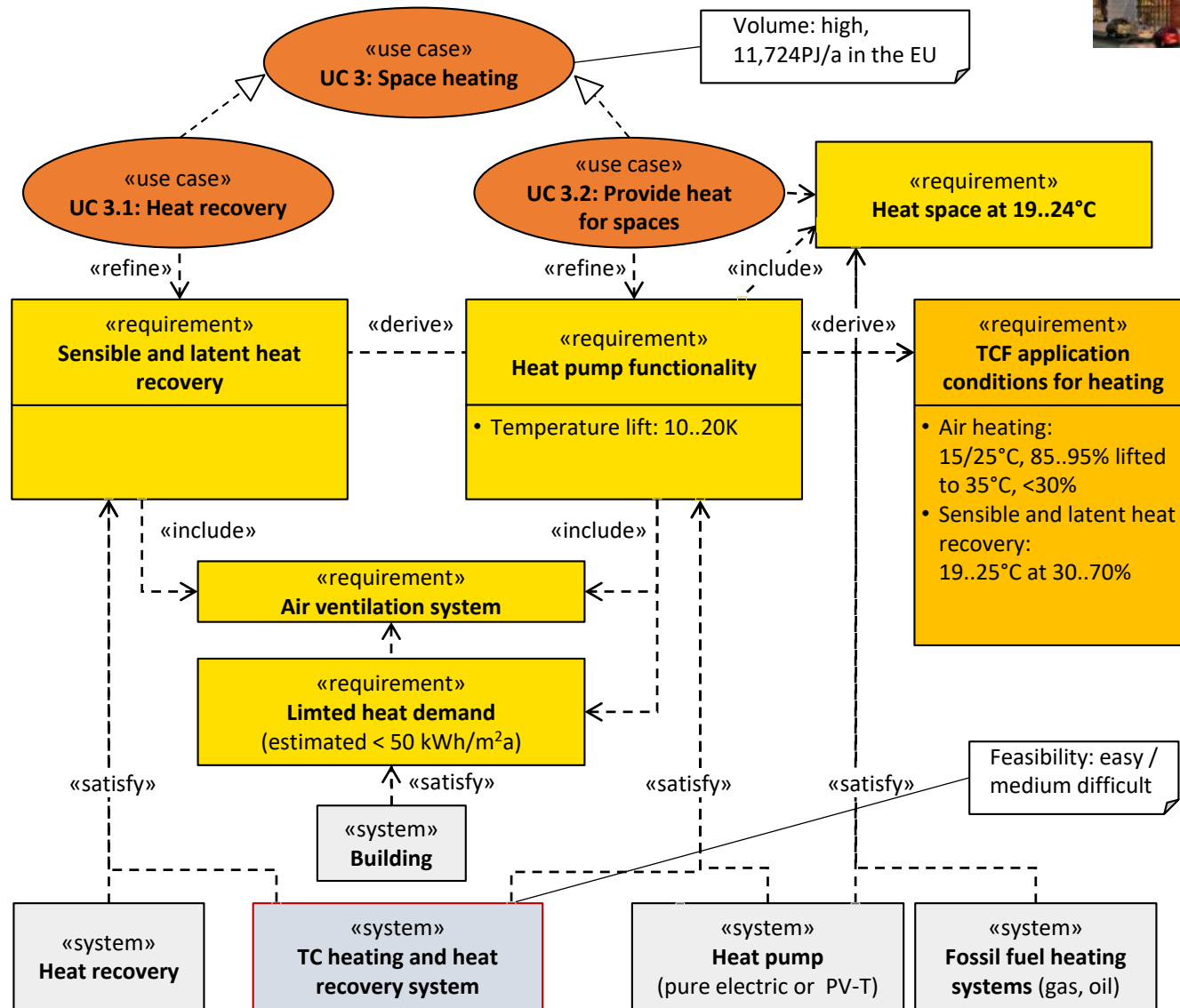
Humidity control combined with heating and cooling • Better indoor climate creates value • Investments often are not dividable among tenants

ROI <5-10 years • Higher value of building • Protection of building against humidity damages

Performance guarantee; Deadlines / budget; Maintenance

Integrator (installer, subcontractor)

Use case 3: Space heating

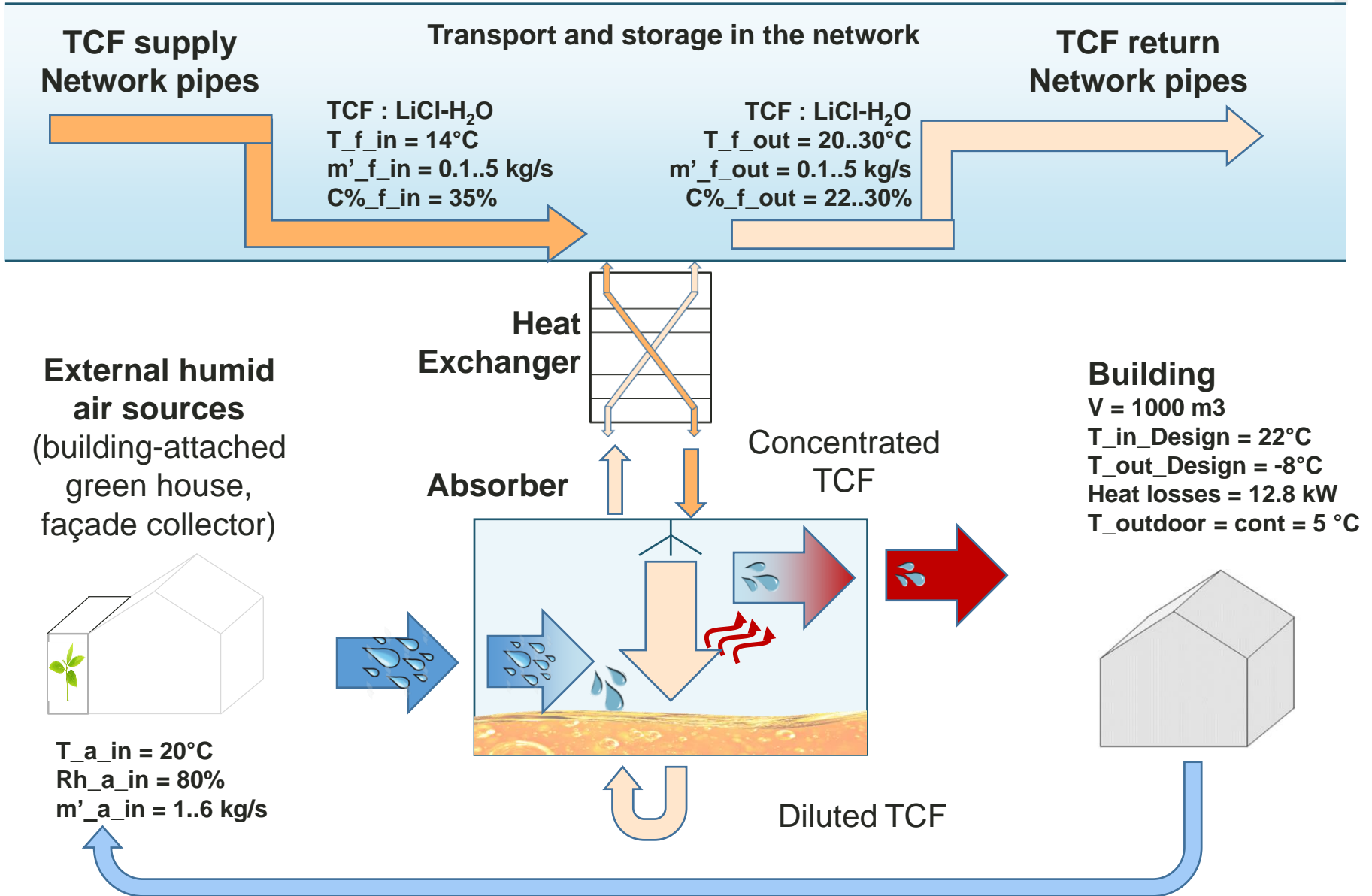


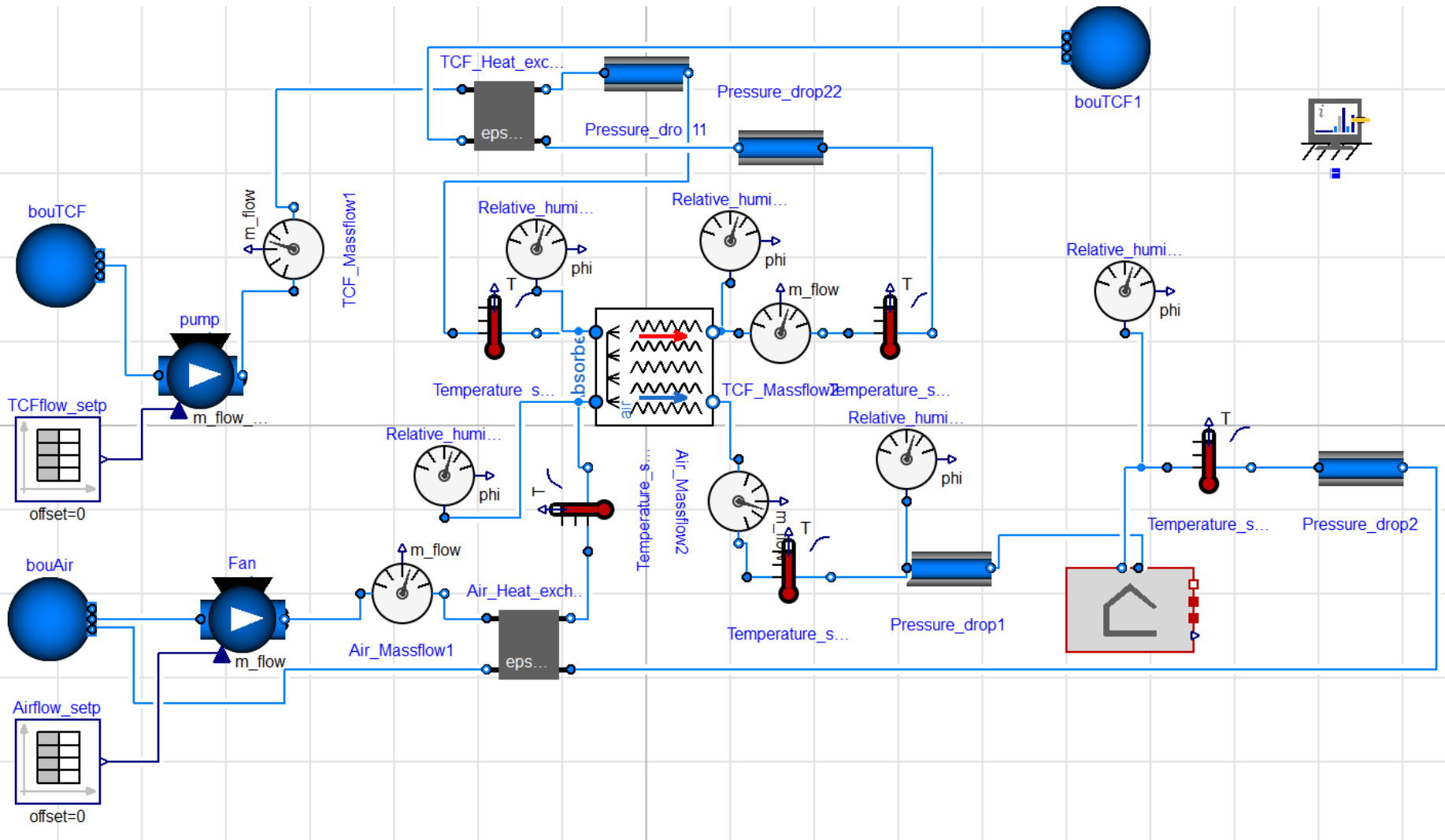


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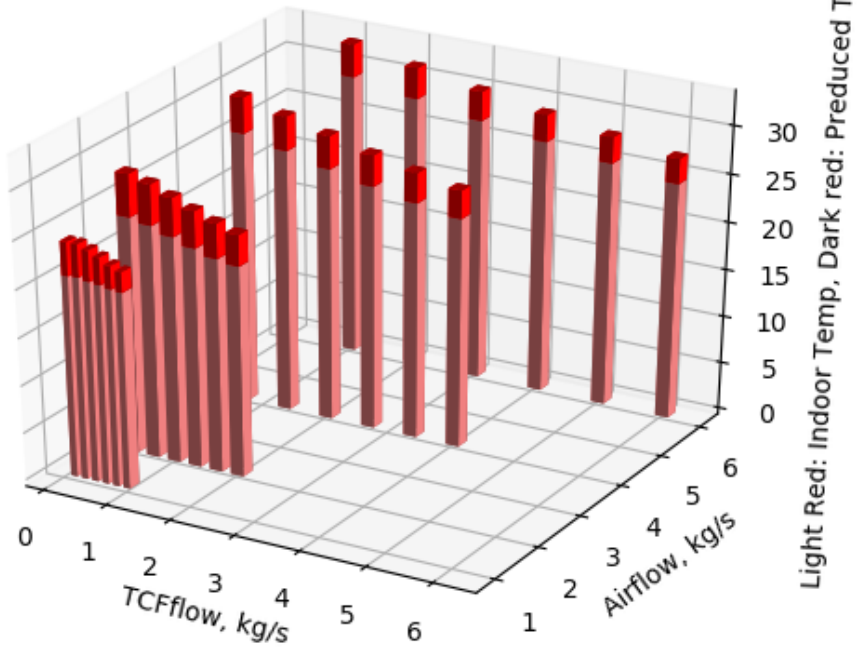
Heating and heat recovery

Scheme and assumptions for simulation

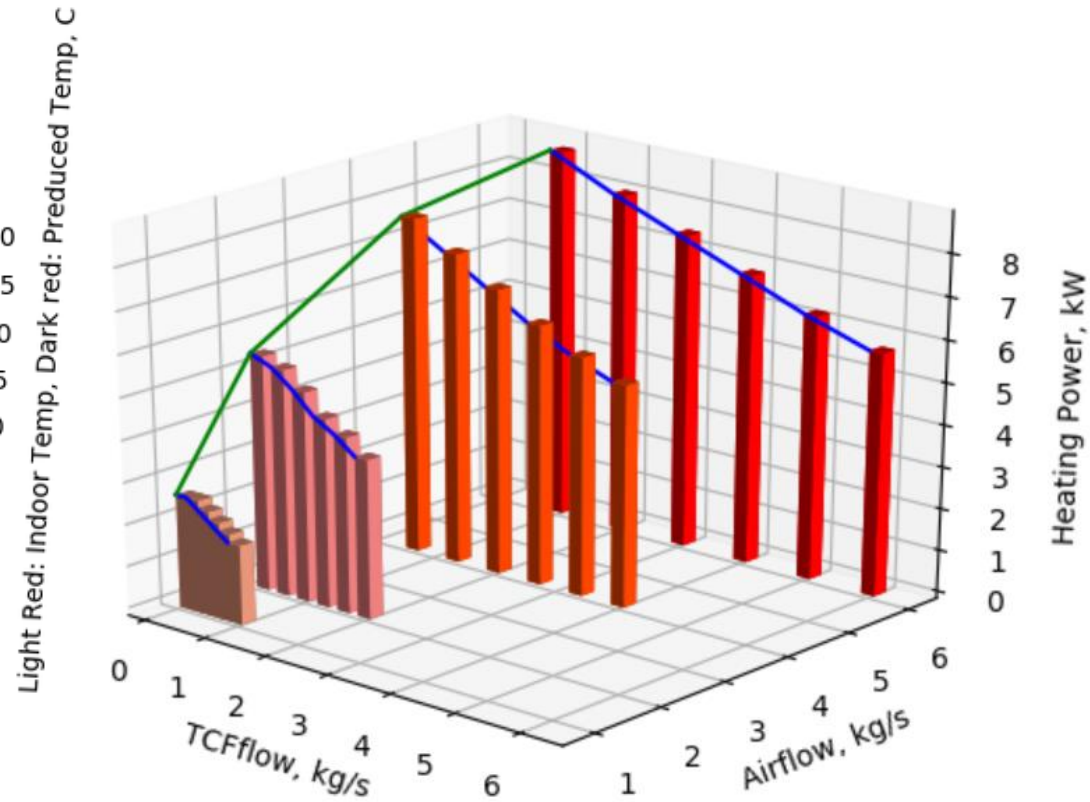




Temperature vs airflow and TCF flow



Heating power vs airflow and TCF flow

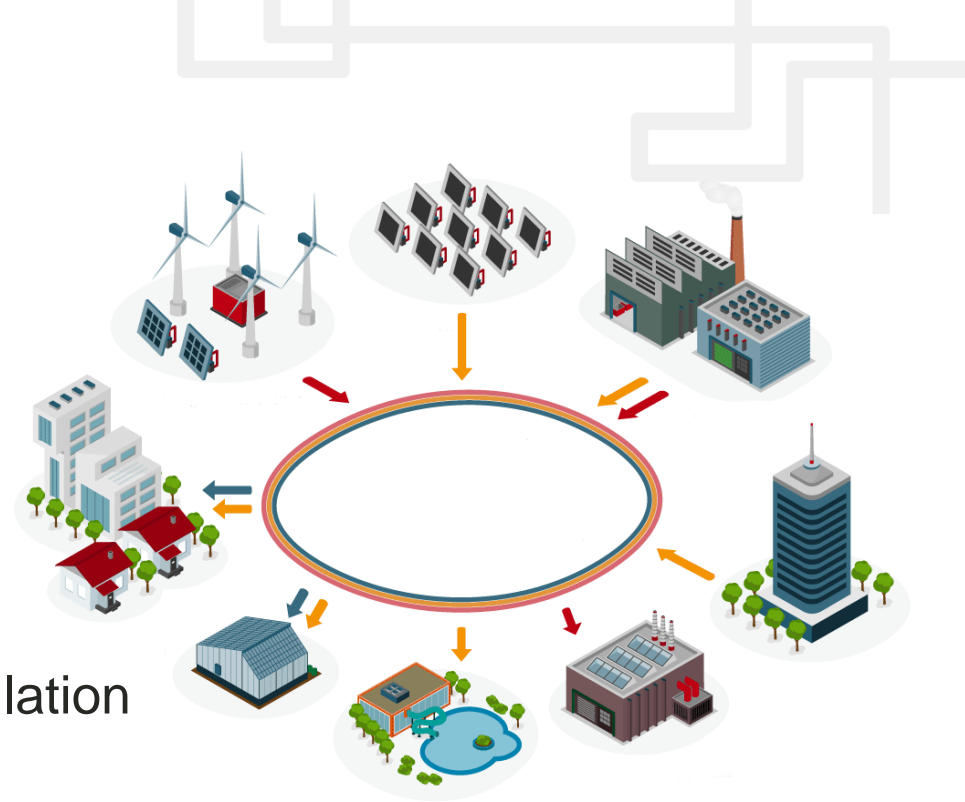




Conclusions

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- Three services:
Heating, Cooling, Drying
- Return-flow exploitation
 - Extending network capacities
 - Interesting new service:
Drying/Humidity control
- Heating has been shown in simulation
 - Low-temperature
 - High air recirculation



Future work:

- More realistic simulation
- Switch from physical multi-node simulation to quick-responding substitute model (machine learning) for simulation and control
- System-level validation of models at demonstrators
- Case studies on networks examining economic and environmental performance