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Bundesministerium für Wirtschaft und Energie
aufgrund eines Beschlusses des Deutschen Bundestages

Thermo-Chemische Netzwerke zur nachhaltigen Energieversorgung auf Basis niedrig temperierter Abwärme

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3. BMUB Fachtagung "Klimaschutz durch Abwärmenutzung"
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- Prinzip Thermo-Chemische Netzwerke
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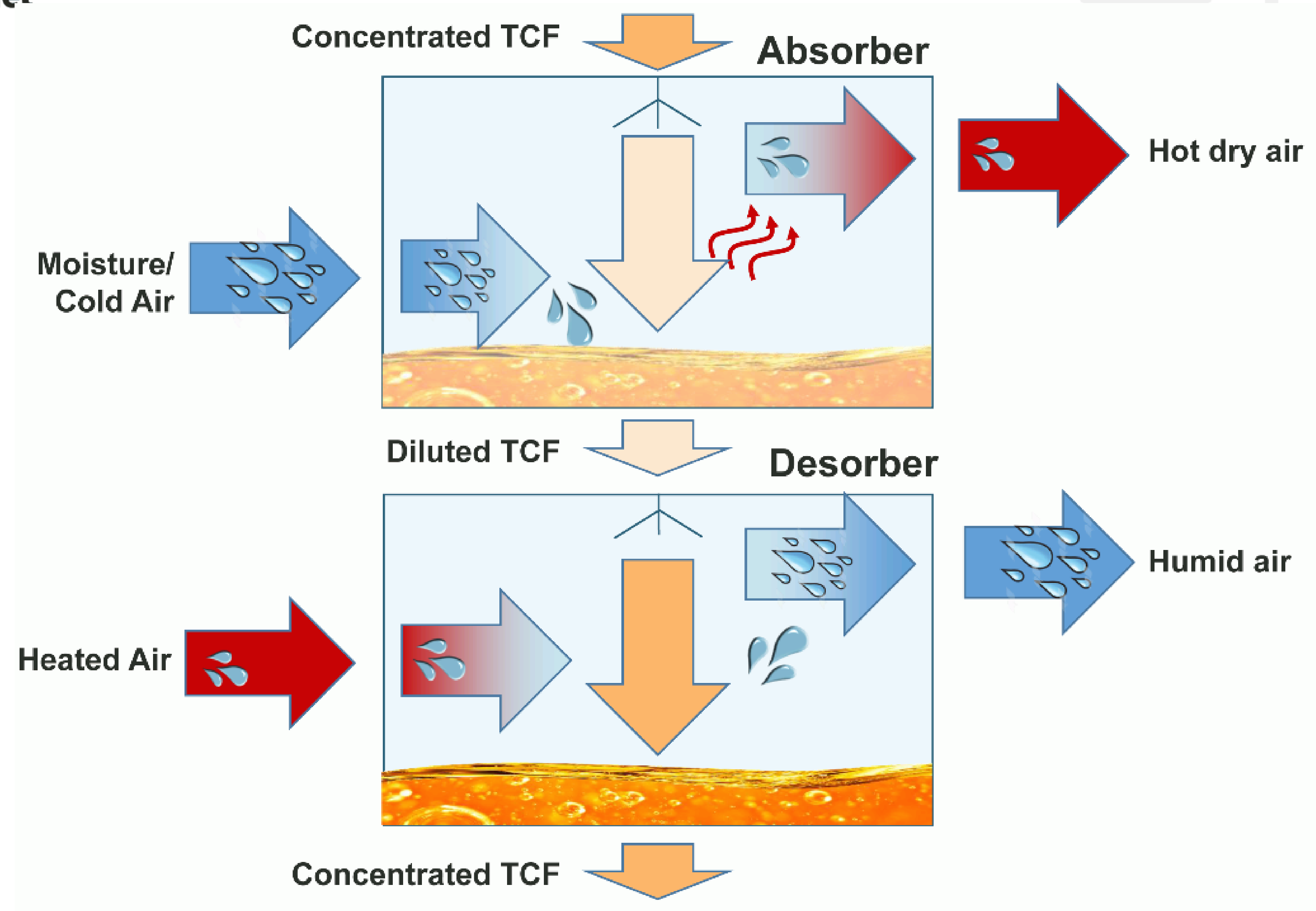
  - Winterthur (CH)
  - Newcastle (UK)
- Anwendungsstudien

Prinzip Thermo-Chemische Netzwerke



Drei wesentliche Vorteile der Thermo-Chemischen Netzwerktechnologie

- **Bereitstellung**: Zur Bereitstellung des hochkonzentrierten Sole kann Abwärme im Bereich
- **20-60° C** verwendet werden. Diese ist sonst kaum verwertbar

- **Netzwerk**: Während Speicherung und Transport des Konzentrats entstehen **keine thermischen Verluste**. Es wird keine Isolation benötigt

- **Gebäude**: Nach der ersten Phase der Gebäudesanierung mit Dämmung von Fassaden und Fenstern besteht vorwiegend **nur noch lüftungsbedingter Heiz- bzw. Kühlbedarf**. Mit flüssigen Salzkonzentraten kann im Gebäude die Luftfeuchtigkeit präzise reguliert, Luft gereinigt und Wärme zurückgehalten werden.

Deliverable 2.1: Application scenarios

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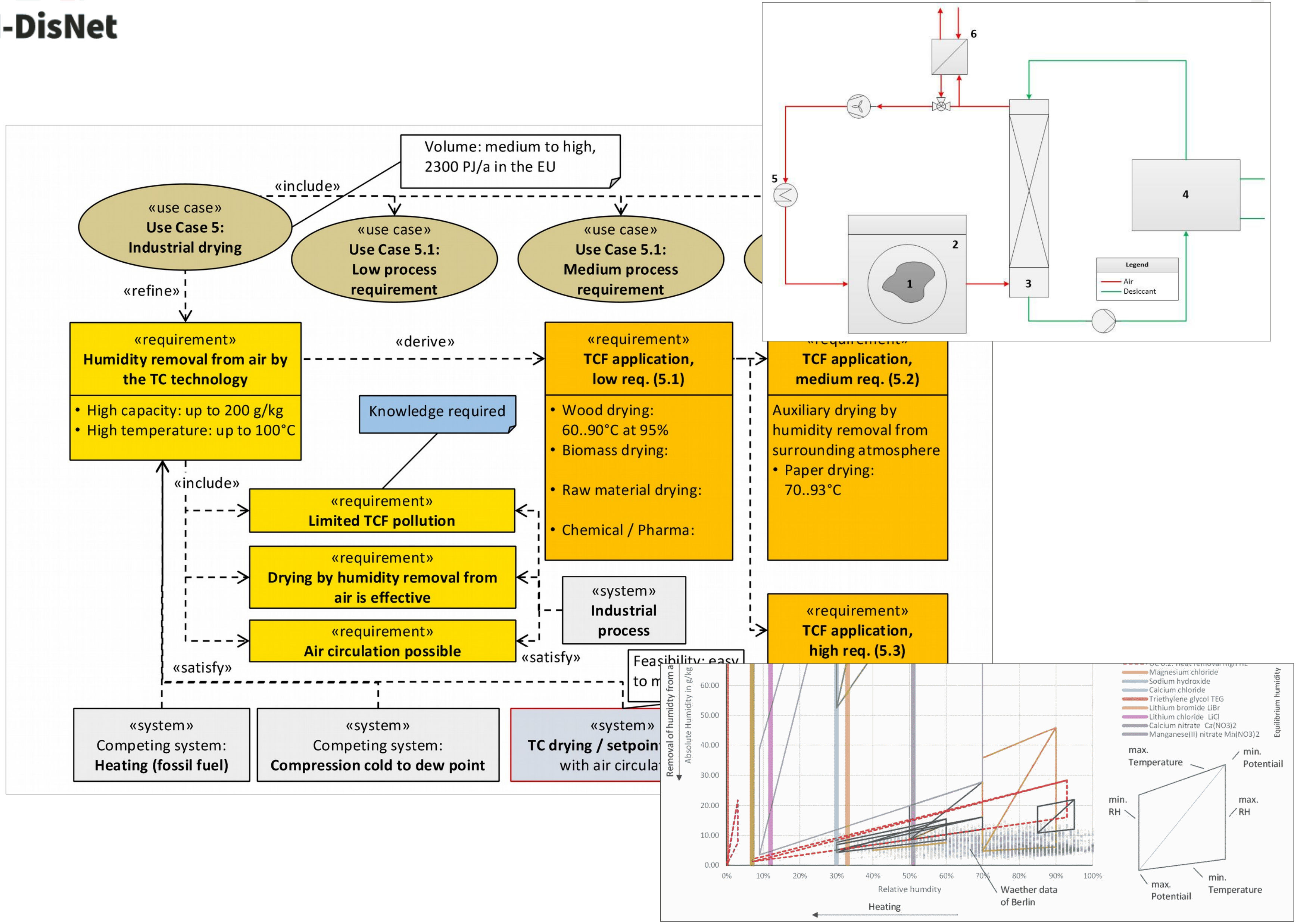
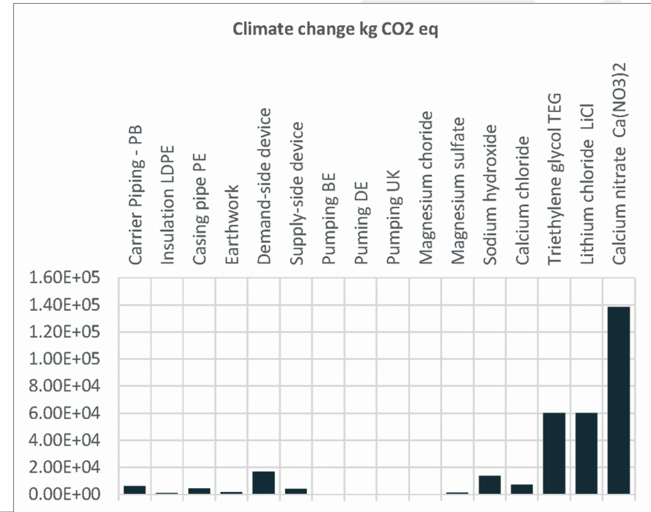
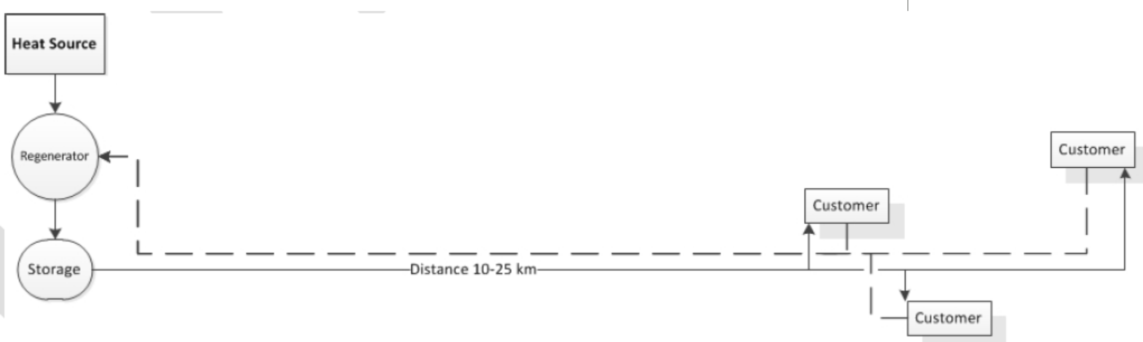
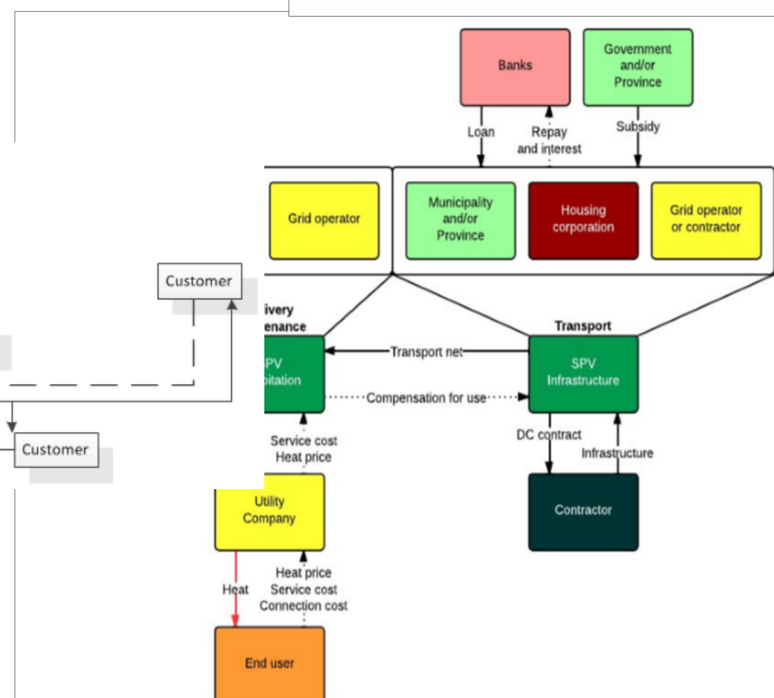


Deliverable 4.1: Business Models and LCA

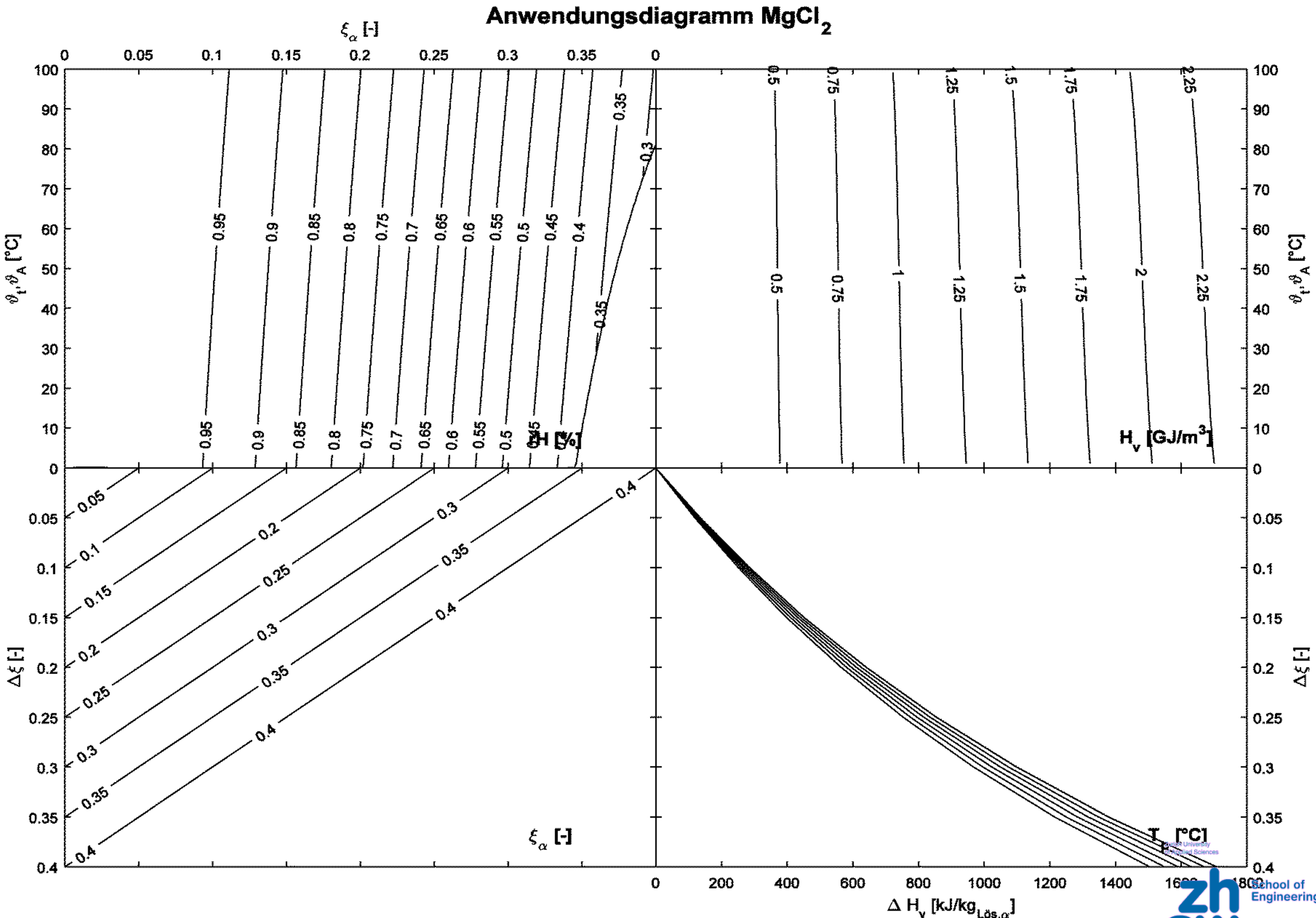




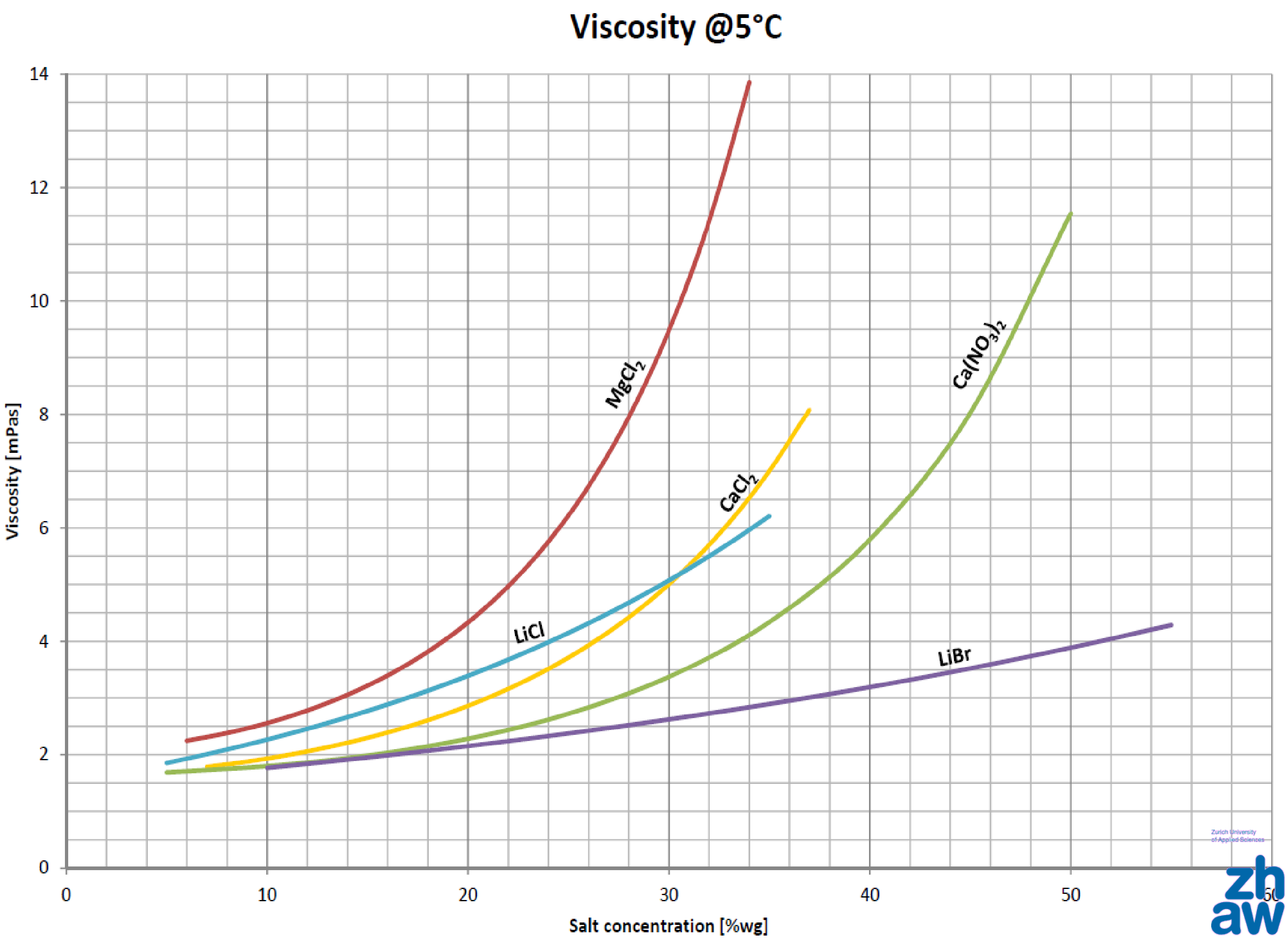


Investment costs	3.440.000
Amortization regenerator unit	375.000
Amortization desiccant storage	270.000
Transport costs	816.000
Cost of waste heat (0,01 €/kWh)	1.044.480
Total annual costs	2.505.480
Income from product (0,03 €/kWh)	3.916.800
Total net income	1.411.320
Return of Investment (years)	2,44

Properties of thermo-chemical fluids (ZHAW)



Viscosity and power in pumping station (ZHAW)



Zurich University of Applied Sciences
zh aw School of Engineering
IEFE Institute of Energy Systems and Fluid Engineering

Corrosion protection

Steel vs Plastic (eg PB-1)

Material	Temperature range under pressure (°C)	Typical applications	Advantages	Limitations	Application in TC network
PVC	-20 to +20	Sewage pipes, water pipes, shrinking tubes for coating	Cheap, good hygienic properties	Not weldable, only solvent or socket connections, hard to recycle	Pipes, fittings, coating
HDPE PE80/PE100	-40 to +20	Water, gas Pipes, Tanks, PE100 with higher pressure reserves	Weldable with PE fittings, flexible	Temperature	Pipes, fittings, valves
PE-RT	-40 to +80	Underfloor heating, heating	Weldable		Pipes, fittings
PP-R	-40 to +70	Heating, plumbing	Weldable,	Low flexibility	Pipes, fittings
PB-1	-15 to +95	Heating, plumbing, DH Tanks,	Weldable, highest abrasion resistance, most flexible, high pressure rating	Low temp (> -15°C) application	Pipes, fittings, valves
PVDF	-20 to +140	Industrial pipes	Weldable, non flexible.	For higher temperature applications	Pipes, fittings
PTFE	-200 to +260	Inliner for Industrial pipes/fittings	Protection for corrosive materials	interesting for low and high temperature applications	Inliner, coating
Ceramics		Inliner	Protection for corrosive materials		Inliner, coating

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EnBA.
Energienetz Berlin Adlershof

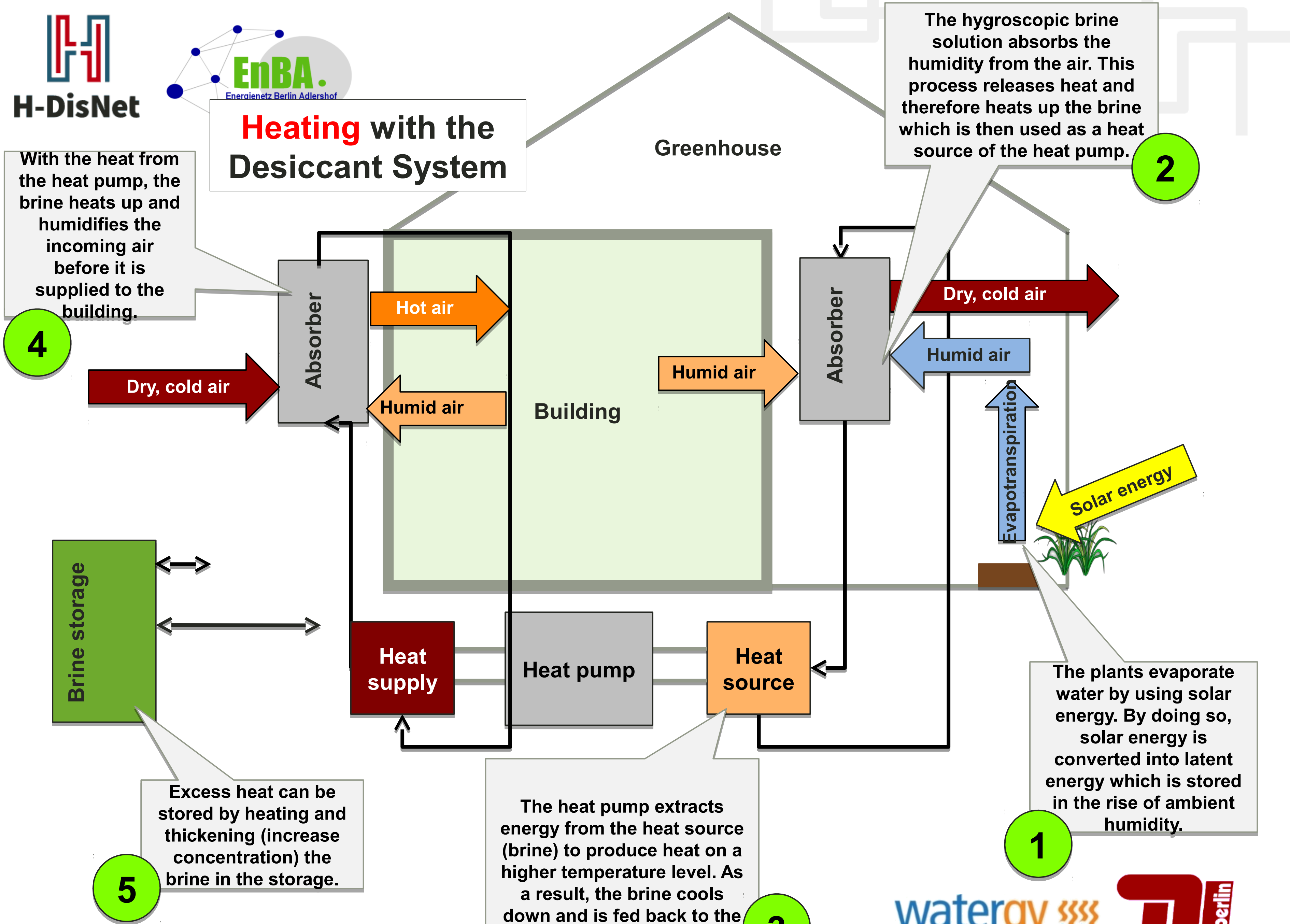
Testlabor TU Berlin

watergy
water and energy solutions

TU berlin

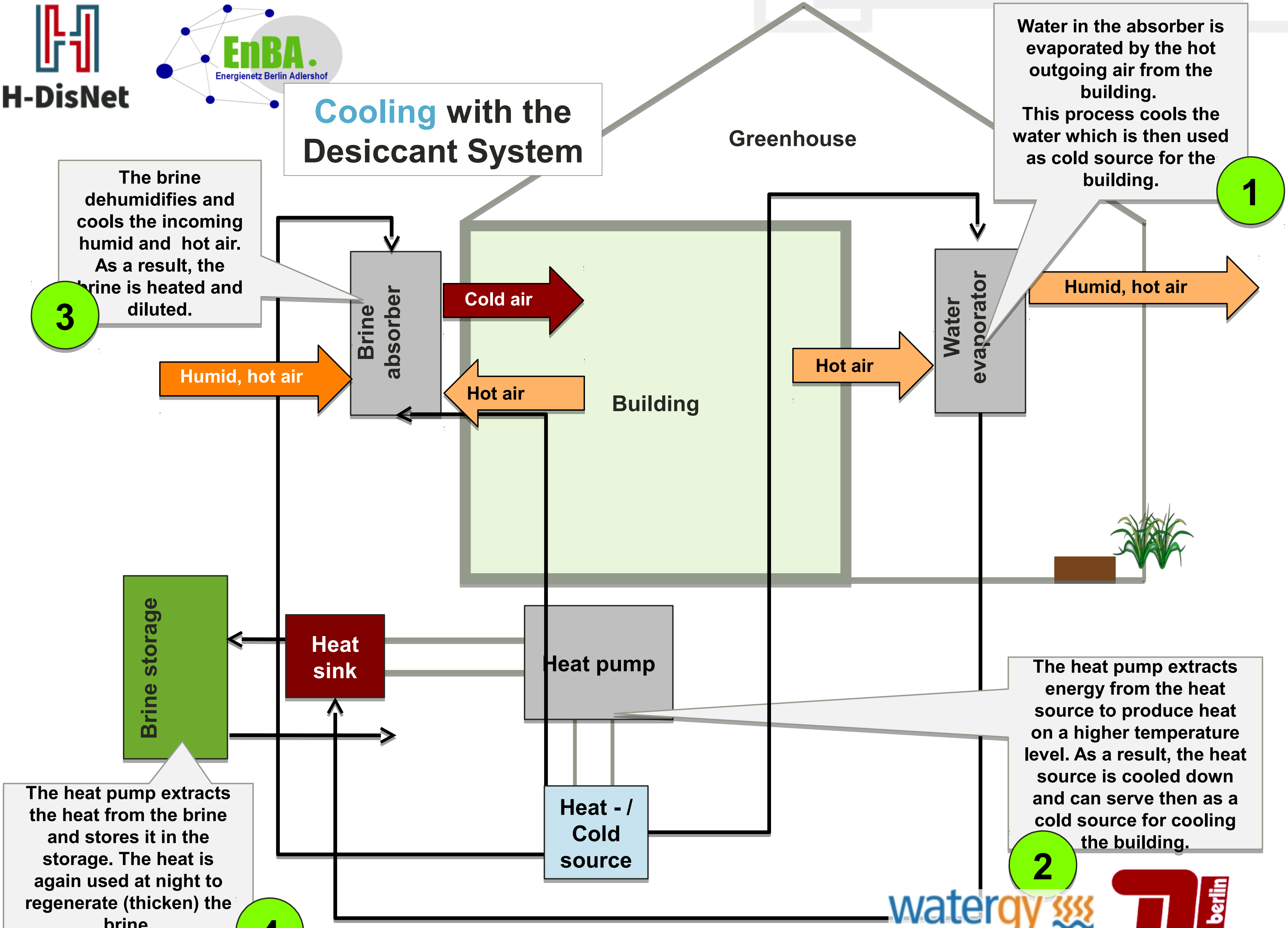
Testlabor TU Berlin

Heating with the Desiccant System



Source: Watergy GmbH, Patent EP2631549

Cooling with the Desiccant System



Source: Watergy GmbH, Patent EP2631549

Testgebäude Berlin Adlershof

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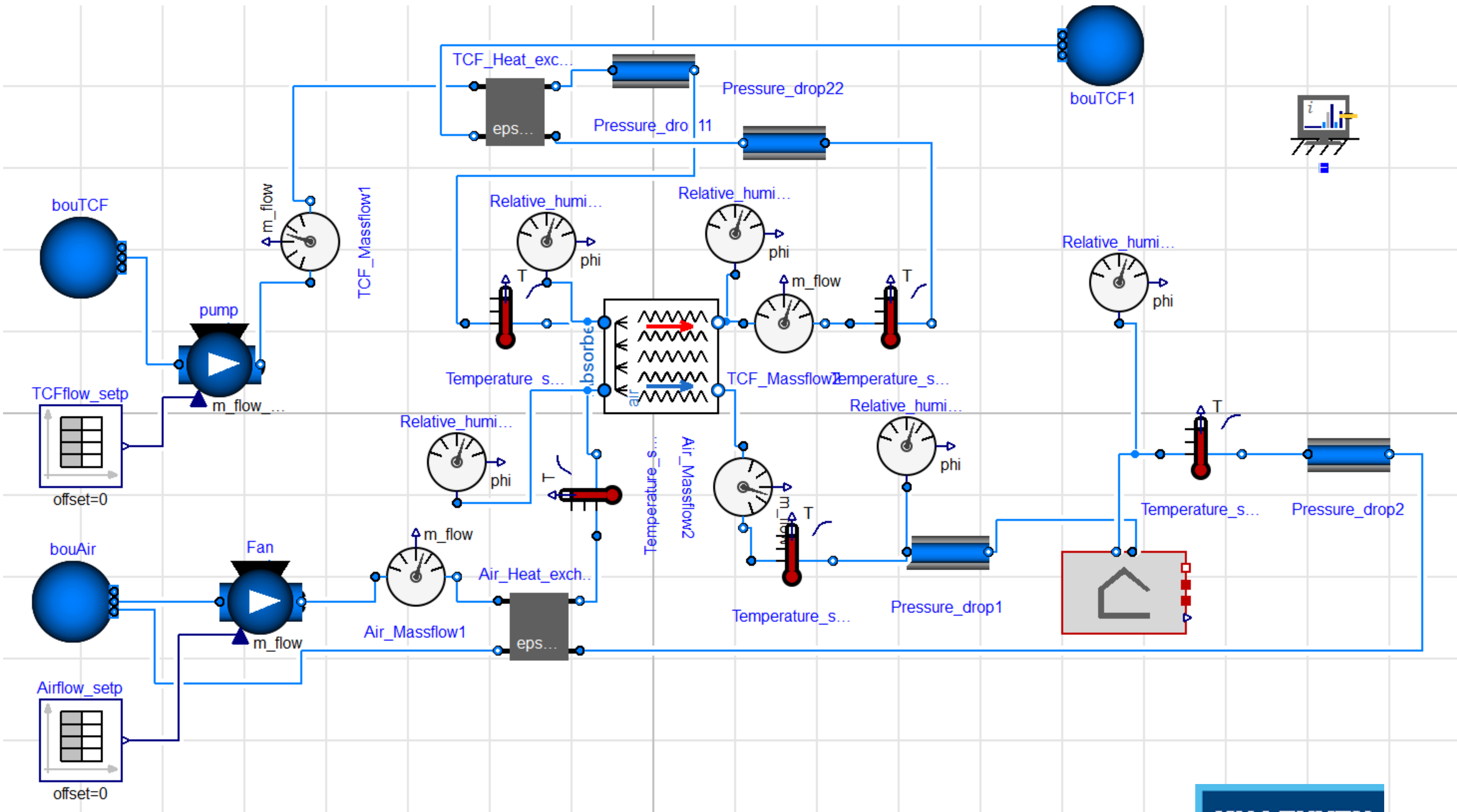
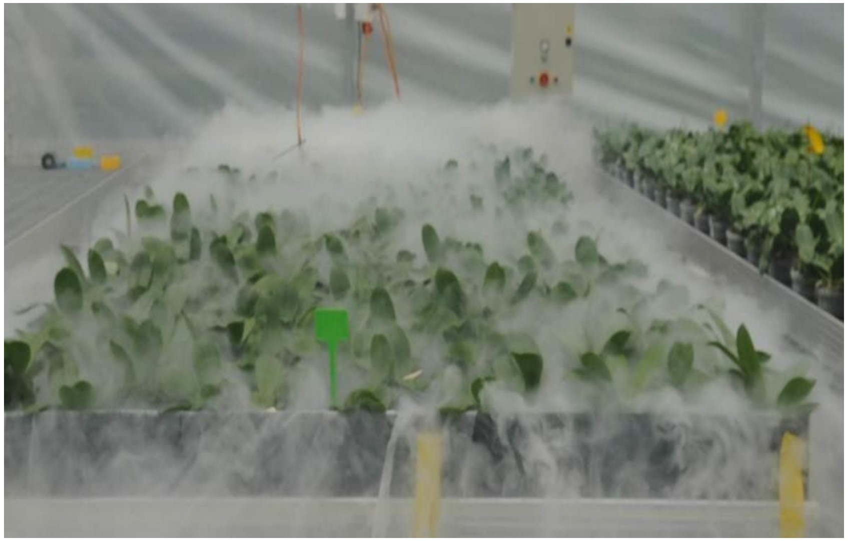
KU Leuven Modelica Simulationsmodell



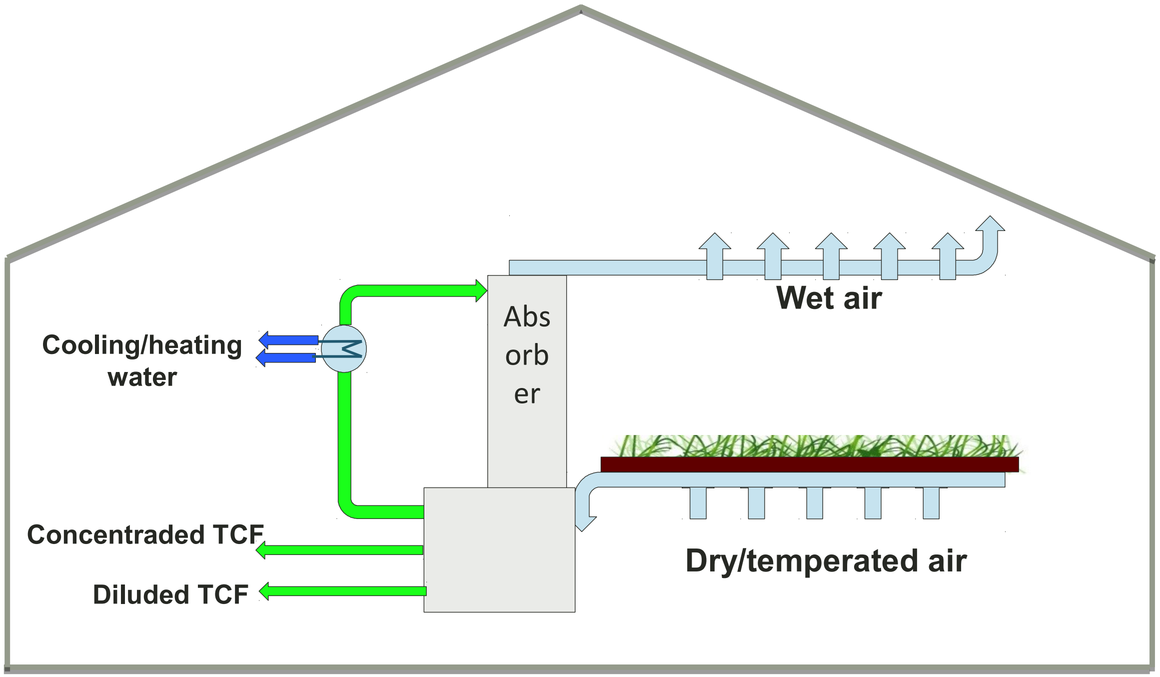
ZHAW Winterthur (CH) Gewächshausanwendung

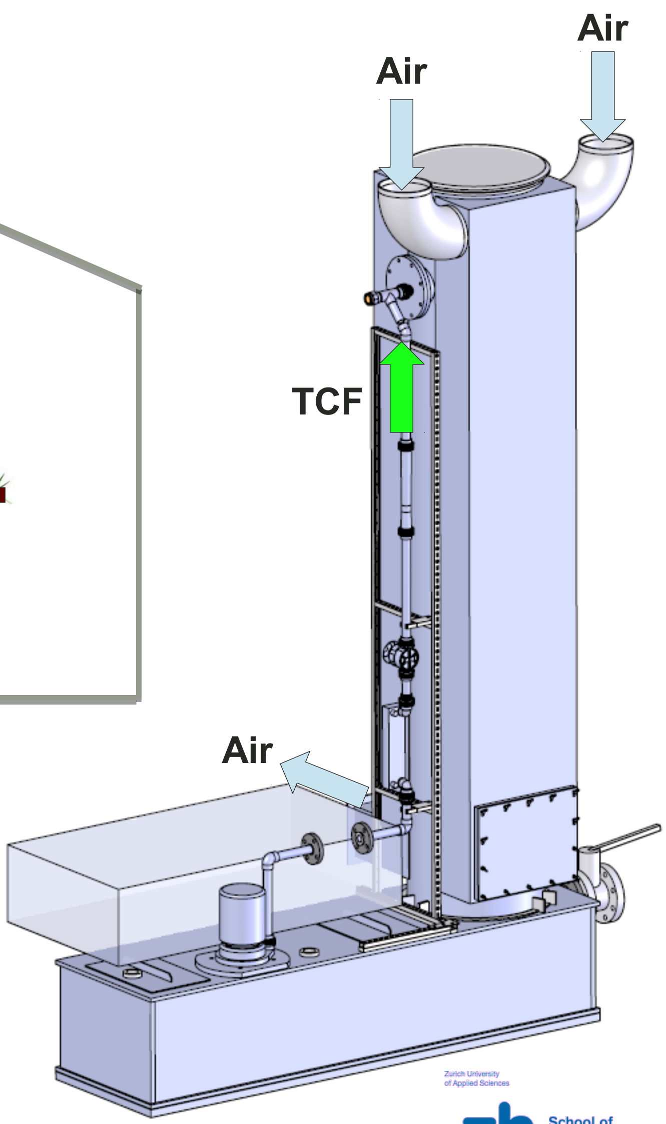


New air distribution system:
the air is fed directly below the crops

- **different climate zones in a green-house room**
- **energy saving**

ZHAW Winterthur (CH) Gewächshausanwendung





Adiabatic absorber:

The TCF is conditioned to the required temperature by water

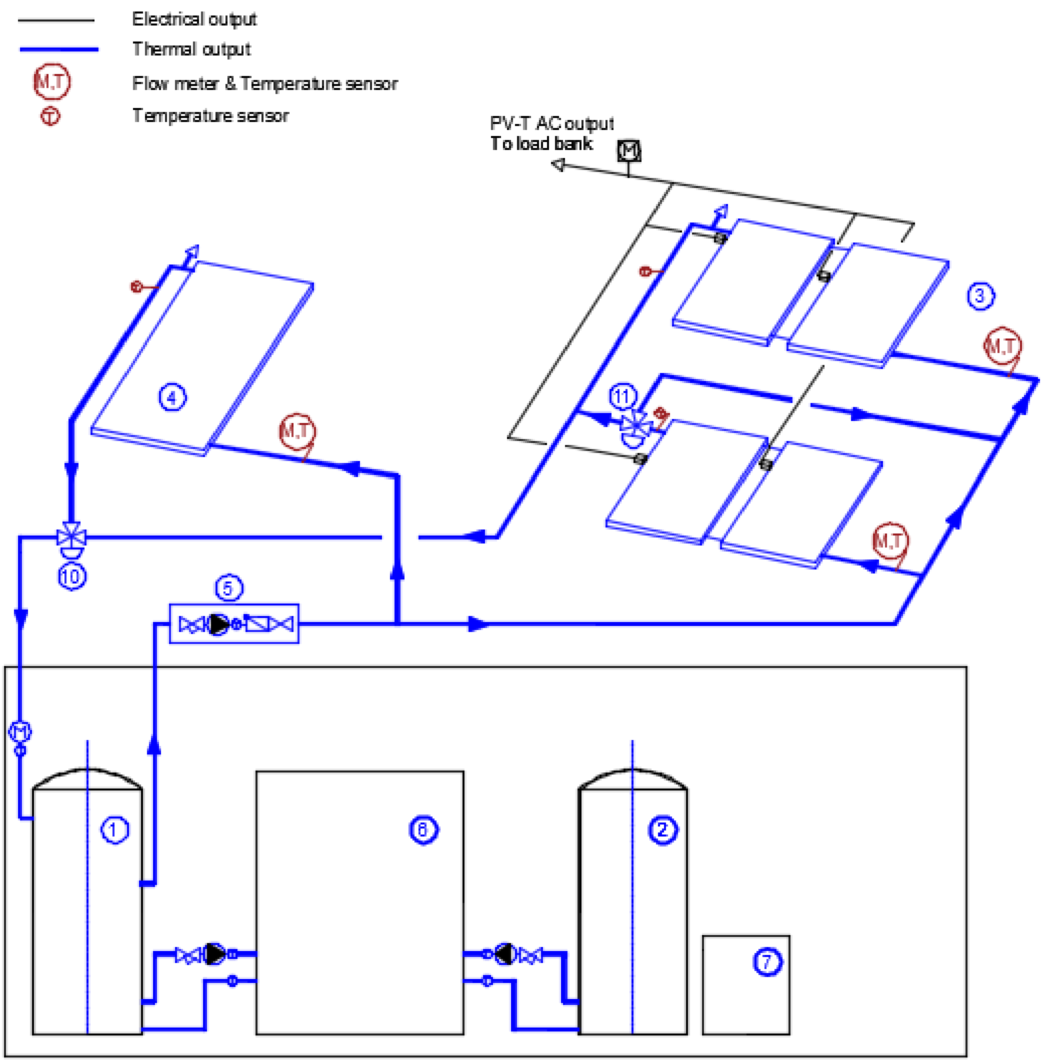
Newcastle (UK) Mobiler Demonstrator

- 20ft container
- readily deployable
- multiple thermal conversion and storage elements

Sir Joseph Swan Centre for energy research

Newcastle University

Newcastle (UK) Mobiler Demonstrator



1. 400l hot water tank (2030 x 550 mm)
2. 400l cold water tank (2030 x 550 mm)
3. 4 x Solar Angle PV-T units (250We / 648W th each)
4. Solar thermal collector (spec TBC)
5. Solar pump station and controler
6. Thermally-Driven Liquid Desiccant Unit
7. Chiller
8. All PV-Ts with micro-invertors and individual meters
9. Anton-Paar Density meter (0.027-0.139 l/s) - (-40°C to 120°C)
10. Motorised or manually operated 3-port mixing valve
11. Motorised or manually operated 3-port diverting valve

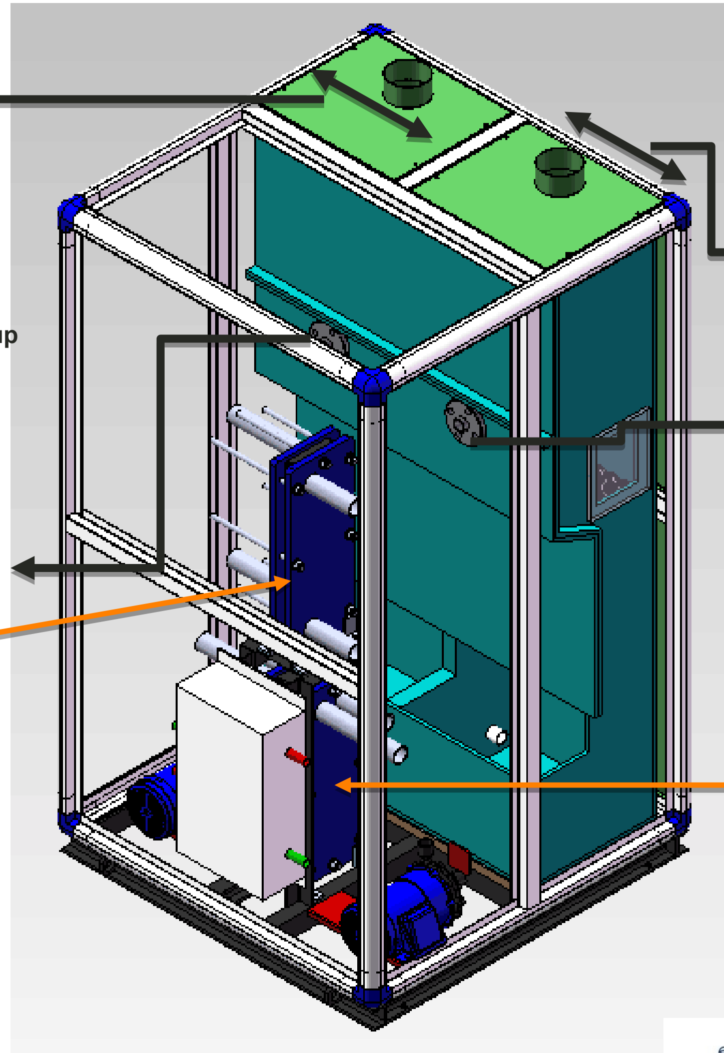
Newcastle (UK) Mobiler Demonstrator

1. State of the demonstrator

- Regenerator side:

Endothermic process (air taking heat from TCF) supporting heating and humidification on the air side (High temp weak TCF gives up heat and humidity to air)

TCF connection from high temp HX



- Absorber side:

Exothermic process (releasing heat) supporting dehumidification/cooling on the air side

TCF connection from low temp HX

High temp HX supplied by PV-T / excess heat via hot water tank
- Low level weak, low temp TFC inlet/High level weak high temp.
- Supplies Regenerator

- Low temp HX supplied by cold water tank
- Supplies absorber

Sir Joseph Swan Centre for energy research

Newcastle University

Newcastle (UK) Mobiler Demonstrator

Thermally driven liquid desiccant fresh air system

Hot humid air
(Regenerator side)

Cold dehumidified air
(absorber side)

Case studies, Beispiele für Netzwerkanwendungen

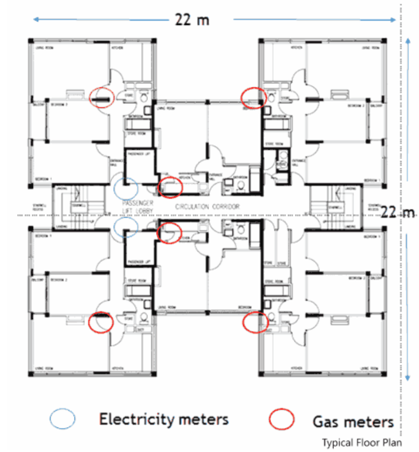
Hasselt

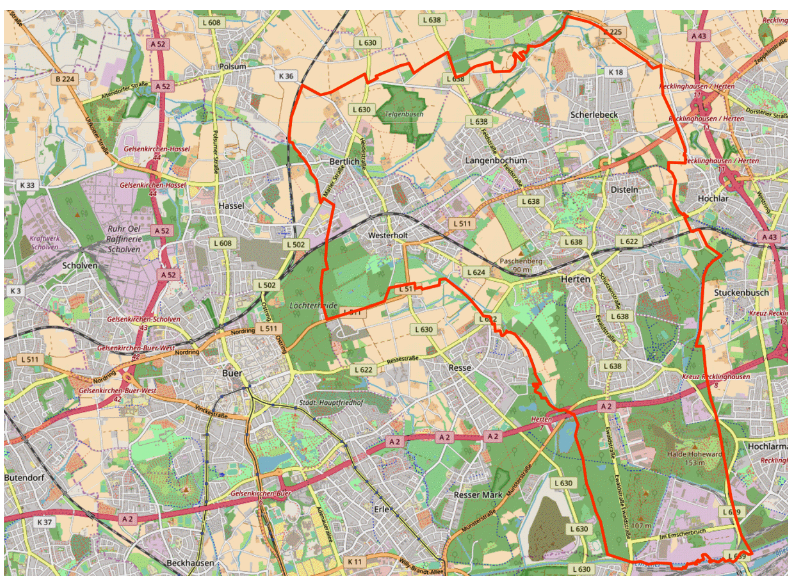
- Typischer Gebäudebestand Mitteleuropa, Heiz,- und Kühlbedarf und Feuchte-regulierung in Gebäuden
- Fluidtransport durch Binnenschiff auf Wasserwegen, Wärmequelle Aurubis AG (ca. 30 km entfernt)
- Optional: Industrielle Trocknung in einer Papierfabrik in Duffel

Bozen

- Thermo-chemische Erweiterung eines sehr innovativen Bestandsnetzes
- 3 Nutzer: Neubaugebiet (Wärme/Kälte), Krankenhaus und Produktionsgewächshäuser

Case studies, Beispiele für Netzwerkanwendungen





Newcastle

- Punkthochhaus, Heizen, Kühlen, Feuchteregulierung
- Repräsentative Situation for Bestandserneuerung
- Detailtiere Studie zur Innenraumklimatisierung basiernd aud vorhandenen Monitoring Daten und Berechnungsmodellen

Herten, Ruhrgebiet (in Vorbereitung)

- Bestands- und Neubauvorhaben
- Hohe Abwärmepotenziale
- Teil eines Antrags für innovative regionale Energiestrategien