

SWEET DeCarbCH – Some insights on Decarbonisation of Cooling and Heating in Switzerland

<https://www.sweet-decarb.ch/>

Contribution to IEA Experts' Group on R&D Priority-setting and Evaluation (EGRD) on Climate Neutral Heating and Cooling: R&D needs & perspectives for international collaboration

20 April 2023

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Zürcher Hochschule für Angewandte Wissenschaften



Content

- Intro
- Thermal grids
- Industrial energy demand
- CCS
- Key messages
- Dissemination

Energy context Switzerland

Policy objectives

- Halve GHG emissions by 2030 relative to 1990
- Net zero GHG emissions by 2050

Energy system

- Electricity
 - close to zero carbon
 - Phase out of nuclear
- Space heating
 - Older buildings: mostly **oil & gas**
 - Newer buildings: mostly heat pumps
 - District heating
- Industry
 - Hardly any heavy industry

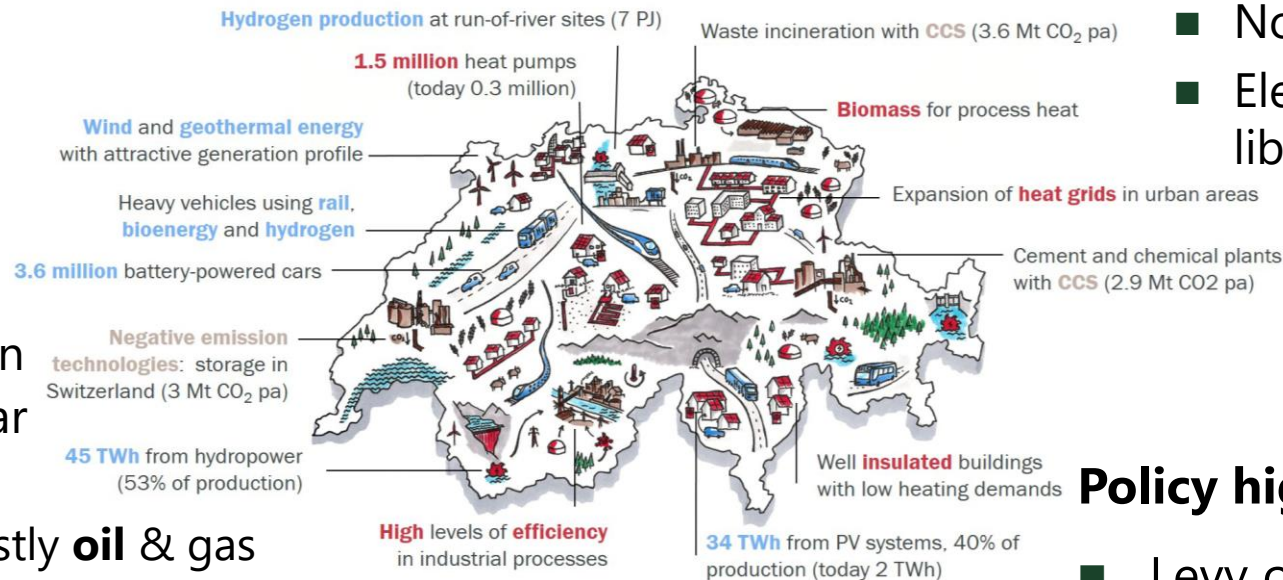


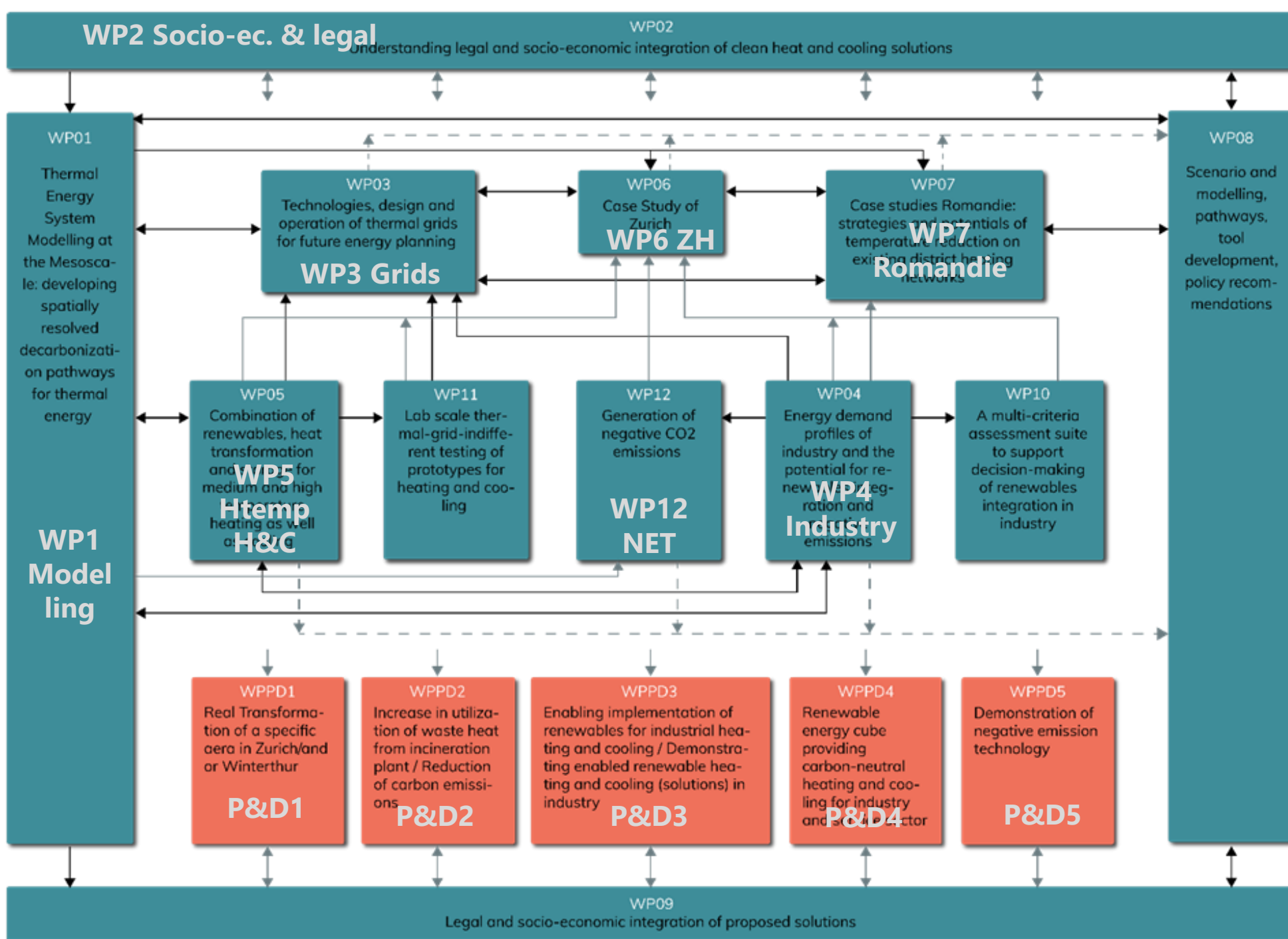
Figure: SFOE and Prognos, Energy perspectives 2050+

International context

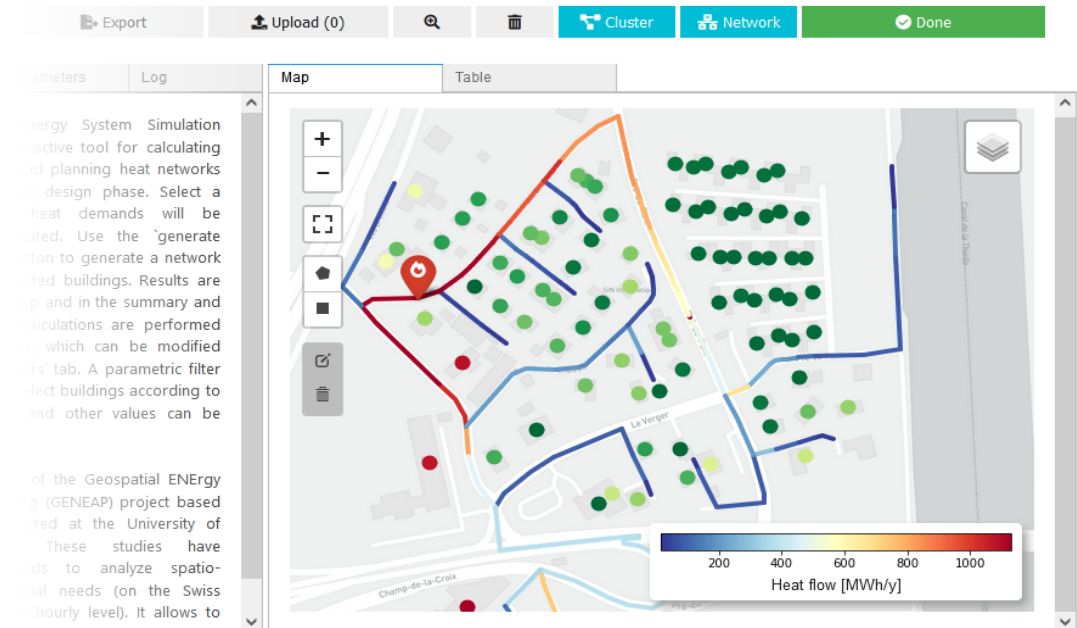
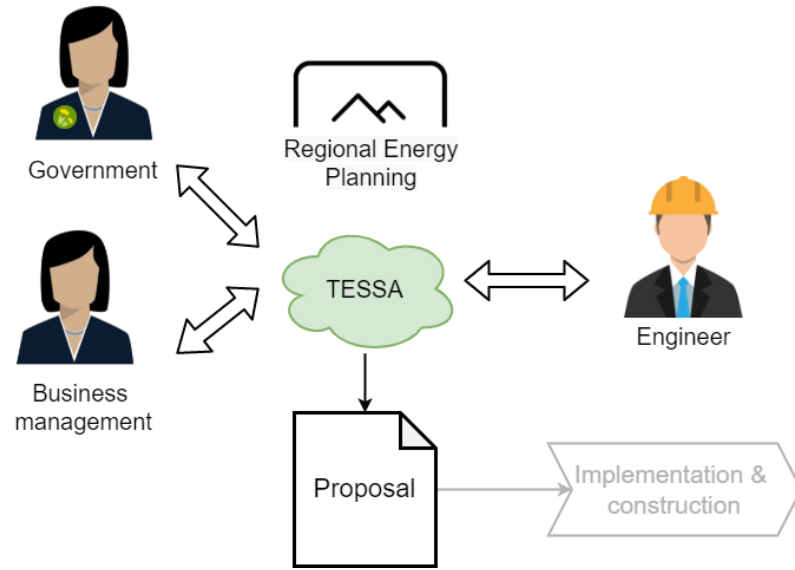
- Fragile security of supply
- No framework agreement with EU
 - No electricity agreement
 - Electricity sector only partly liberalized

Policy highlights

- Levy of 120 CHF/tonne CO₂
- Tender-based EEPs
- Buildings: subject to cantonal law



Thermal Energy System Simulation Assistant (UNIGE)

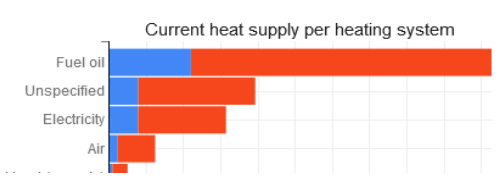


- Interactive network modelling and exploration
- Study alternatives and stakeholder feedback

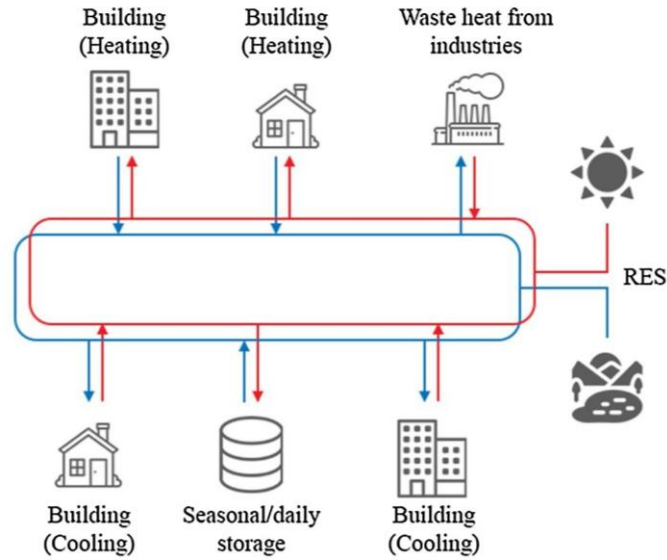


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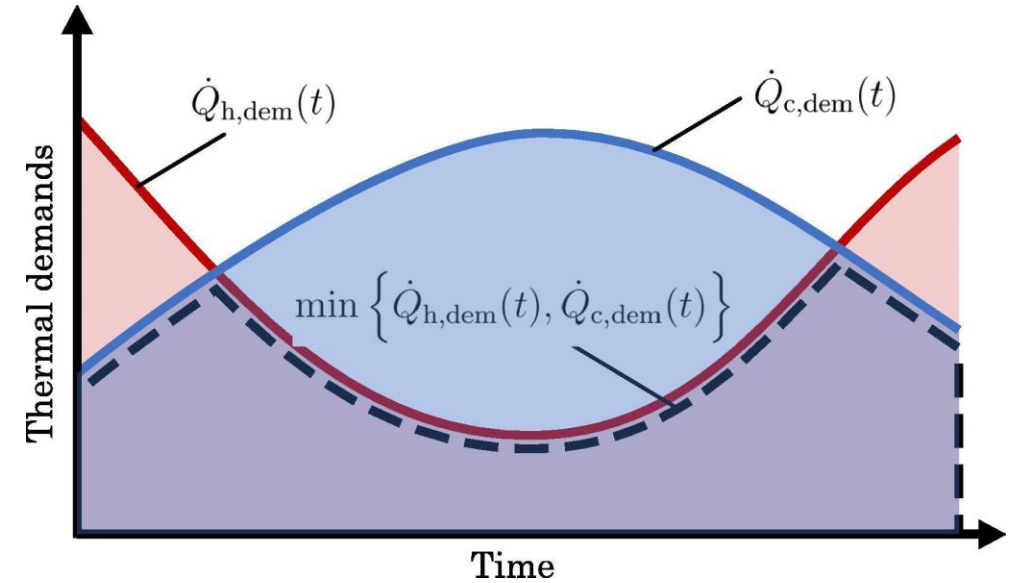
Value	Unit
89	-
2.49	GWh
1.95	GWh
539.59	MWh



5GDHC - 5th generation district heating & cooling (UNIGE)



Feasibility of 5GDHC is related to simultaneous demands, Seasonal TES



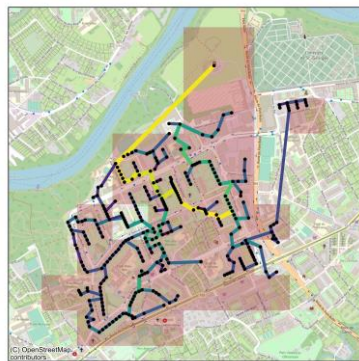
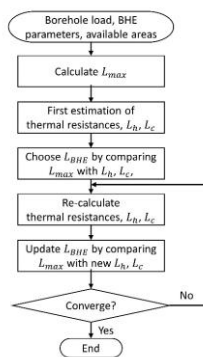
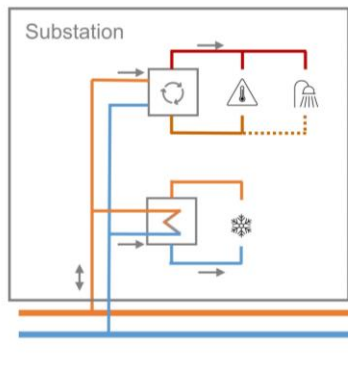
Source: Wirtz, 2020; Millar, 2021; Caputo, 2021

	4G district heating	5GDHC
Flow temperature	~ 50 °C	< 30 °C
User side	Direct heating	Adjustment by HP
Flow direction	Unidirectional	Bidirectional
Heating and cooling	Separate	Combined

Li X, Yilmaz S, Patel M, Chambers J. "Techno-economic analysis of fifth-generation district heating and cooling combined with seasonal borehole thermal energy storage." *Under review, Applied Energy* 2023.

5GDHC - Case Study Performance evaluation (UNIGE)

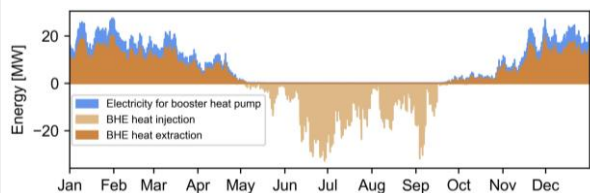
5GDHC design and simulation



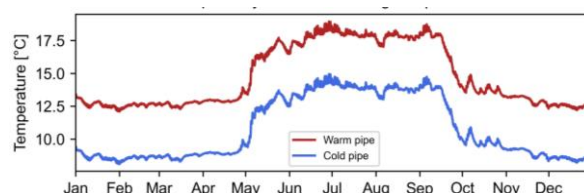
Building substation

Borehole fields

Thermal network

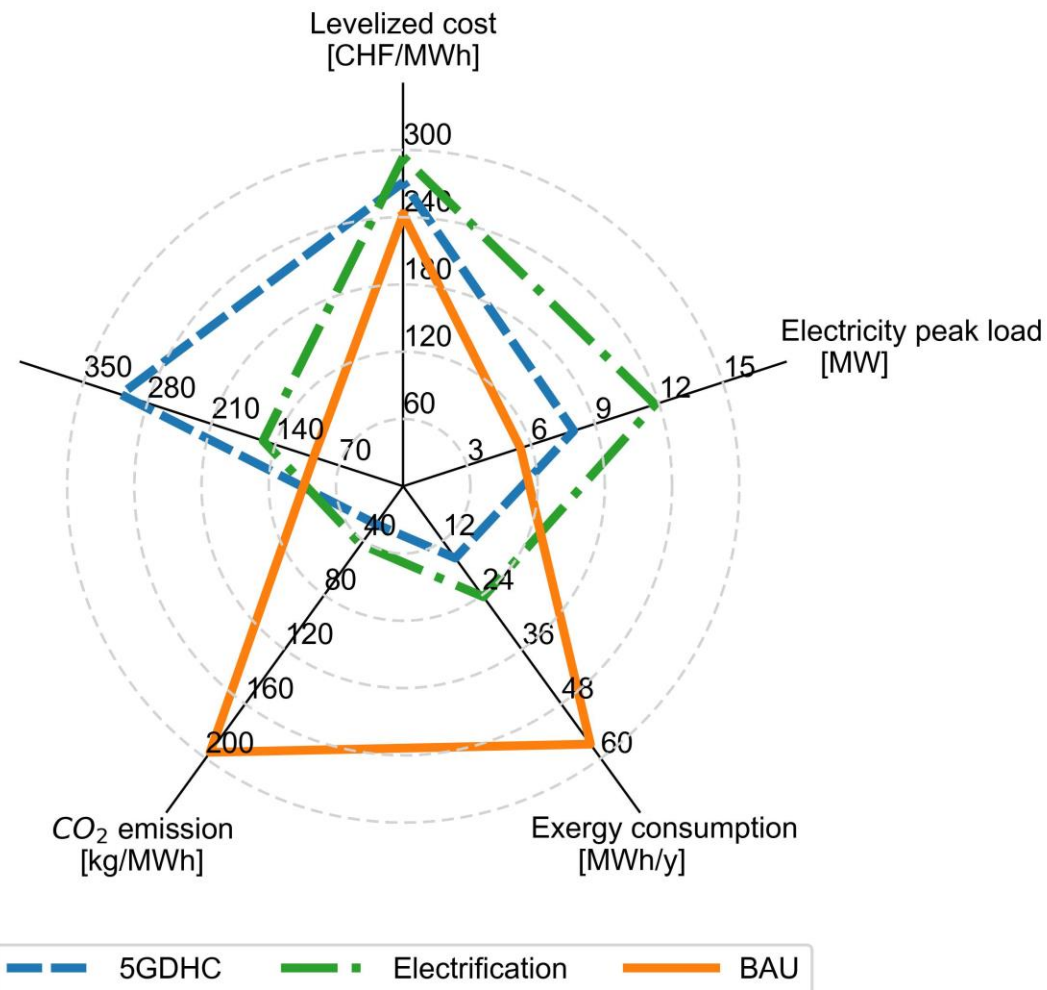


Energy consumption



Temperature profile

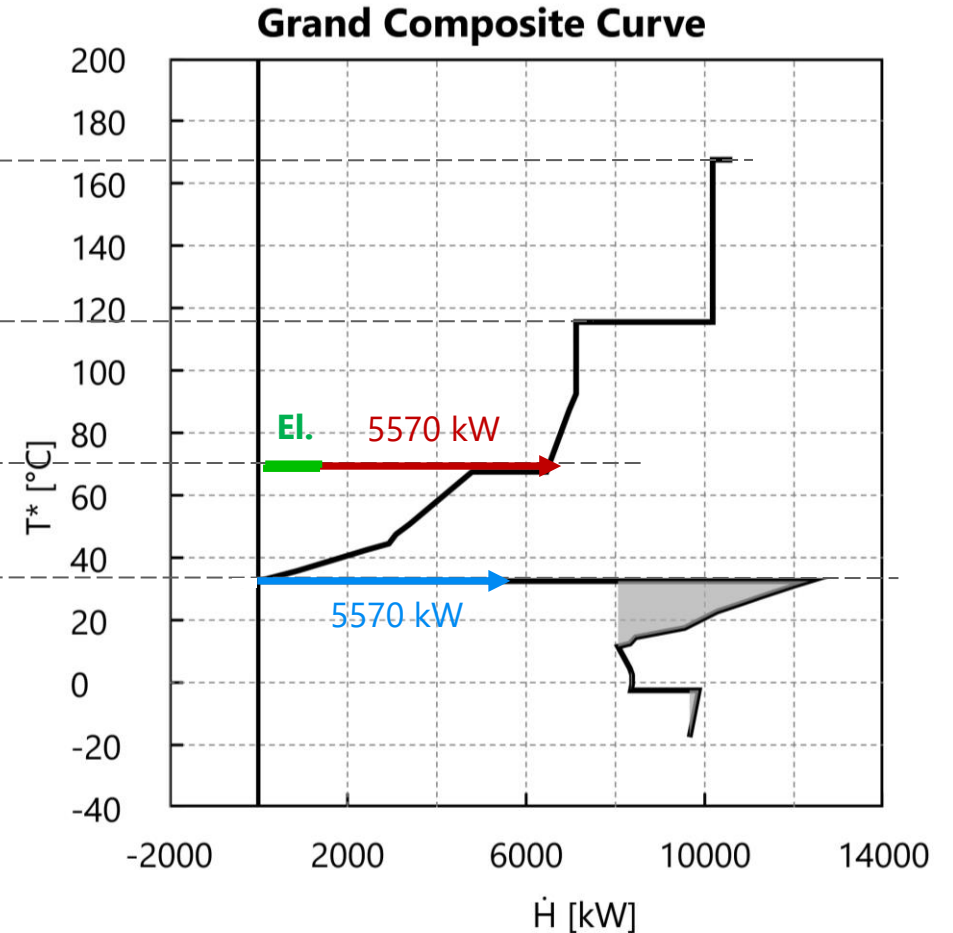
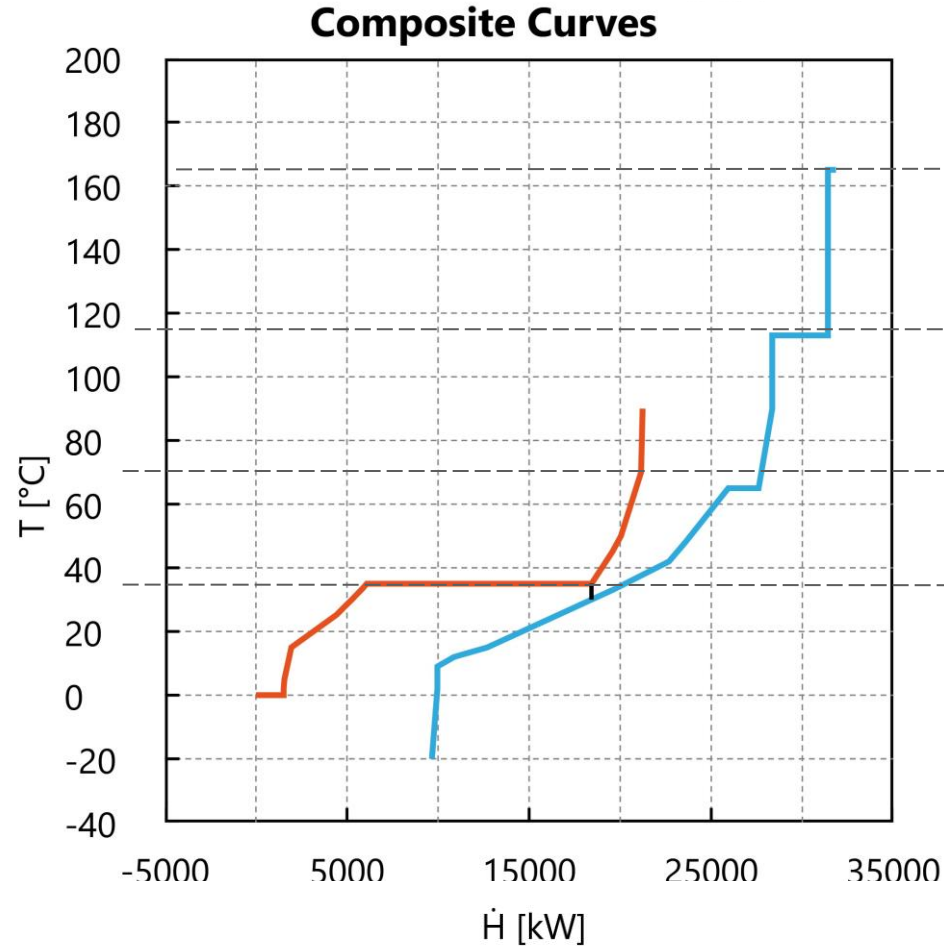
Upfront cost [million CHF]



KPIs of 5GDHC and reference systems

Energy demand profiles for industry (HSLU/UNIGE)

Example: Meat processing (company Bell)



- Most (>90%) of the HP potential had already been implemented.
- HP from 30 °C to 115 °C not considered
- Geothermal energy would be of interest.

CCS (ETHZ)

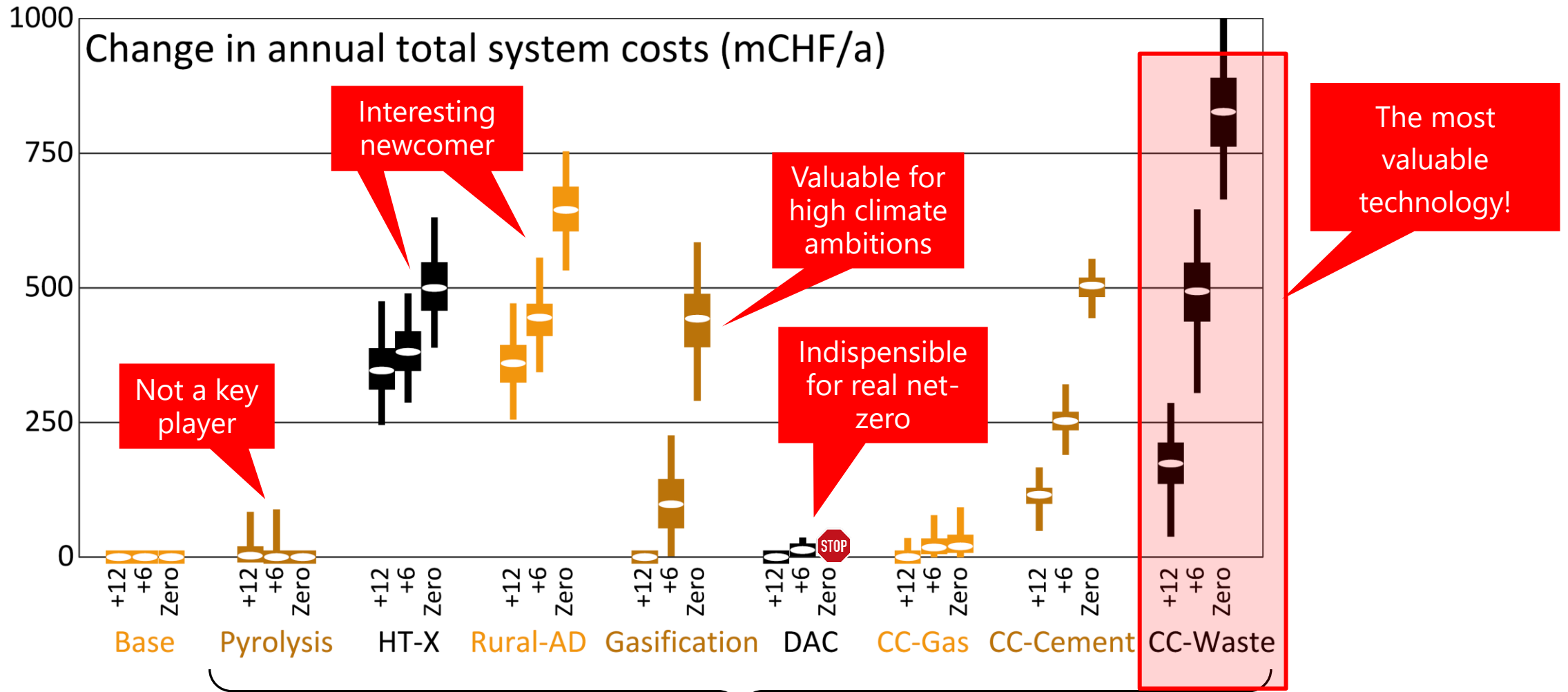
Technology options

- CC-Waste: CO₂ separation on waste, wood and sludge CHP plants
- CC-CEM: CO₂ separation on cement plants
- CC-Gas: CO₂ separation on gas CHP plants
- Gasification: Wood gasification to produce hydrogen, SNG, kerosene
- HT-X: Hydrothermal gasification / liquefaction / carbonization
- Pyrolysis: Wood pyrolysis to produce charcoal
- Rural-AD: Anaerobic manure digestion connected to gas/CO₂ network
- DAC: Direct air capture

Scenarios

- Zero (with agriculture and air travel)
- +6 Mt/a: Domestic without air travel
- +12 Mt/a = +6Mt/a plus 6 Mt/a compensation abroad

CCS Technologies compared



How much more does it cost if this technology is not available

Key messages

- Explorative analyses of thermal grids should become more easily accessible for planners and decision makers.
- Seasonal thermal storage in combination with 5GDHC is promising and should be further studied.
- There is urgent need for CCs/GCCs for industrial processes (let's collaborate on a database!)
- More work needed on CCS (which process combinations, heat integration etc.)

Dissemination - Workshops & Webinar



Steam generating
heat pumps
webinar

1st March at 1:30pm
2023

OST

Image by rawpixel.com & Benjamin Davies on Unsplash



INVITATION
HIGH TEMPERATURE HEAT PUMPS EVENT

24 MARCH 2023 | ITTIGEN

Go to www.sweet-decarb.ch -> events to register

Dissemination - YouTube Channel (1/2)

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RENEWABLE HEAT IS IT ROCKET SIENCE?	Christiane Egger (OO Energiesparverband, ESV)	43:10	49	4 months ago
#dontforgetcooling		0:37	26	5 months ago
CASE STUDY DECARB ZURICH	Armin Eberle (ZHAW)	26:10	57	7 months ago
NEGATIVE EMISSION TECHNOLOGIES (NET)	Gianfranco Guidati (ETH)	26:58	87	9 months ago
THERMAL GRID MODELLING UNDER UNCERTAINTY	Jonathan Chambers (UNIGE)	29:02	86	9 months ago
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Dissemination - YouTube Channel (2/2)

TEMPERATURE REDUCTION IN DH

by Stefan Schneider (UNIGE)



34:53

DeCarbCH Lunch Talk: Temperature Reduction in District Heating by Stefan...

101 views · 11 months ago

THERMAL ENERGY STORAGES

by Jörg Worlitschek (HSLU)



29:19

DeCarbCH Lunch Talk: Long term thermal energy storages by Jörg Worlitschek

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THERMAL NETWORKS

by Tobias Sommer & Stefan Mennel (HSLU)



25:37

DeCarbCH Lunch Talk: Thermal Networks – Challenges and Outlook presented by Tobia...

109 views · 1 year ago

INDUSTRIAL HEAT PUMPS

by Cordin Arpagaus (OST)



33:56

DeCarbCH Lunch Talk: Industrial Heat Pumps presented by Cordin Arpagaus

1K views · 1 year ago

SOCIO-ECONOMIC CHALLENGES

by Matthias Speich (ZHAW)



32:53

DeCarbCH Lunch Talk: Socio-Economic challenges by Matthias Speich

69 views · 1 year ago

PINCH

by Donald Olsen (HSLU)



26:34

DeCarbCH Lunch Talk: Pinch Analysis by Donald Olsen

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