



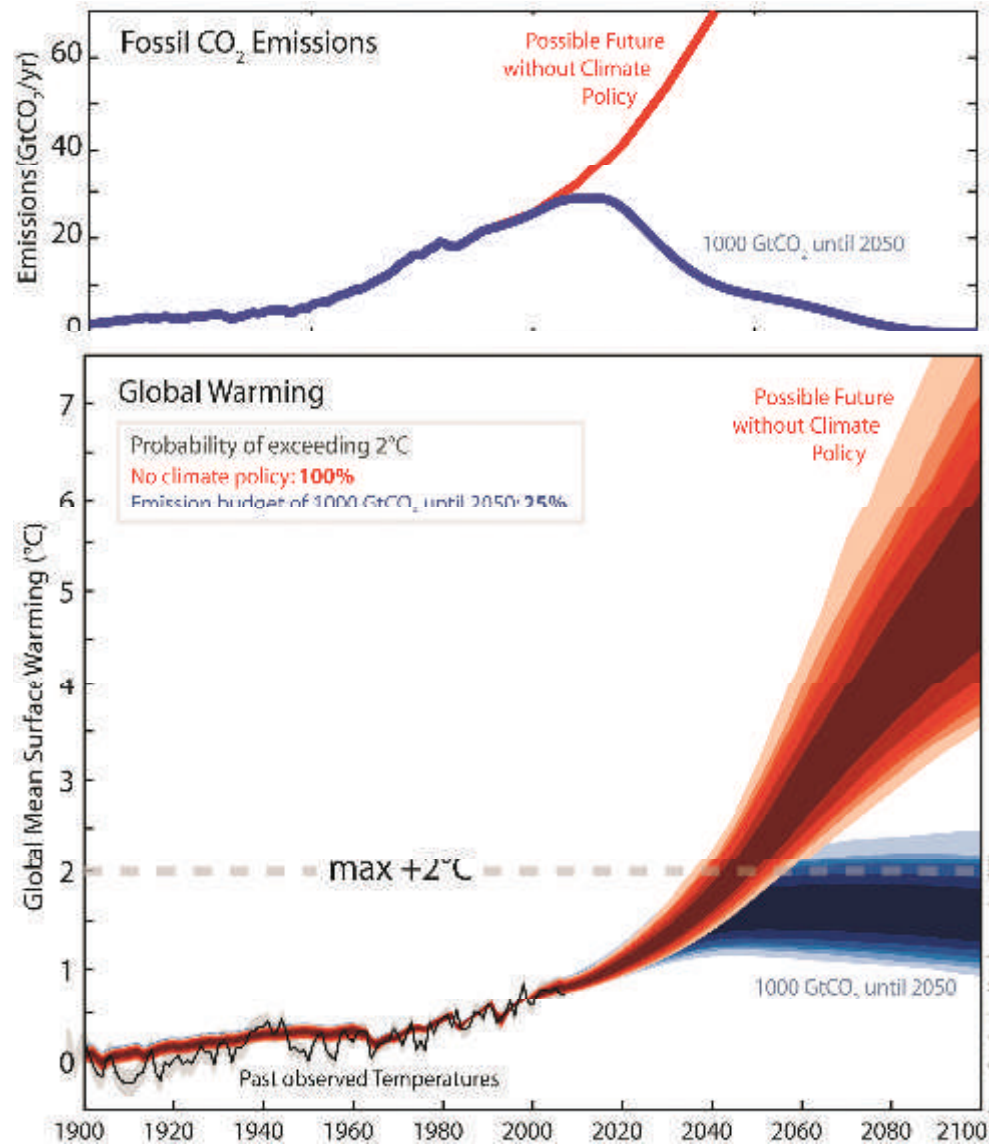
Chair of Building Systems
Prof. Hansjürg Leibundgut

/ ITA
Institute of Technology in Architecture
Faculty of Architecture / ETH Zurich

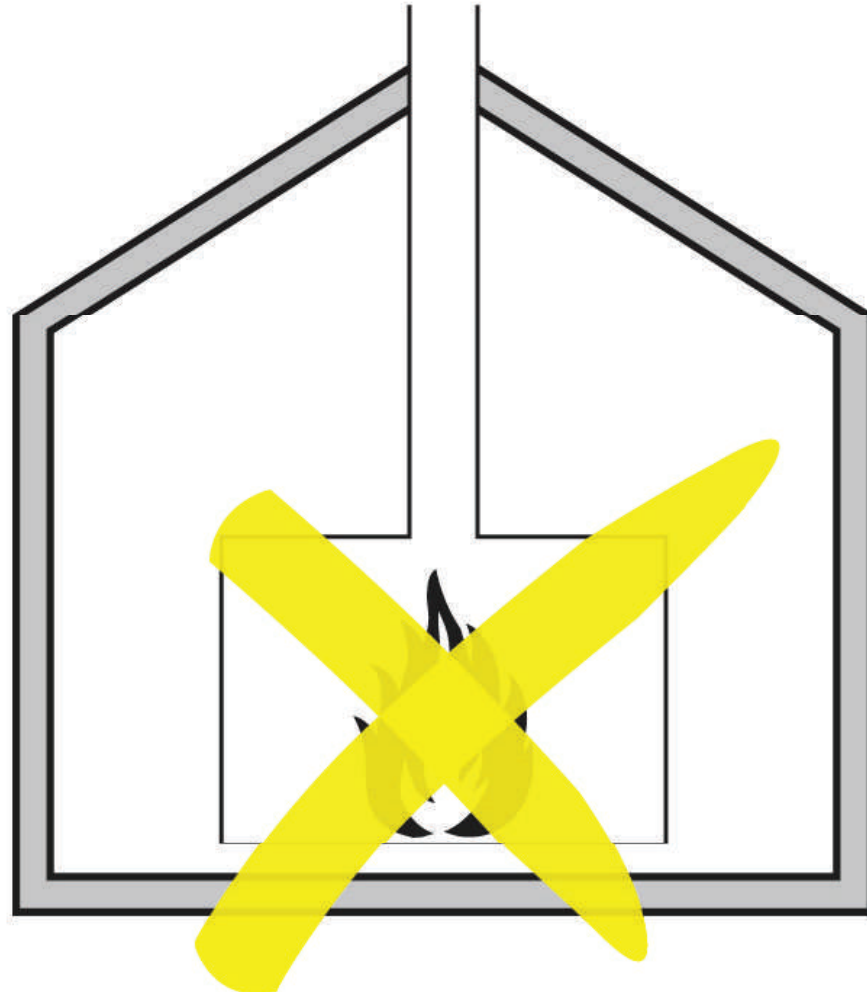


Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich

CO₂ – Budget until 2050



No combustion of fossil fuels



Nuclear accident of Fukushima



No fission of Uranium



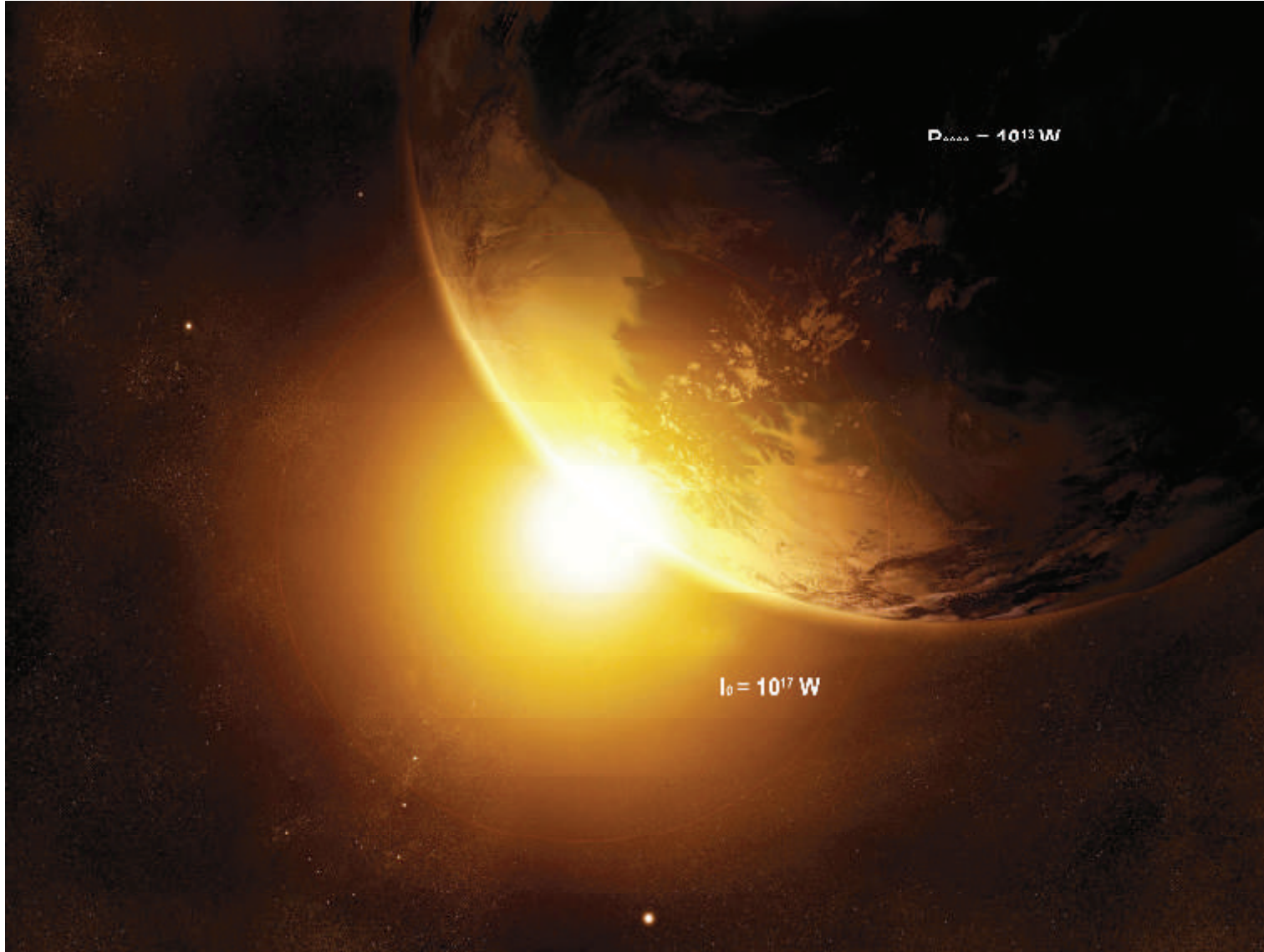
REDEM -Initiative

Gesetzesinitiative:

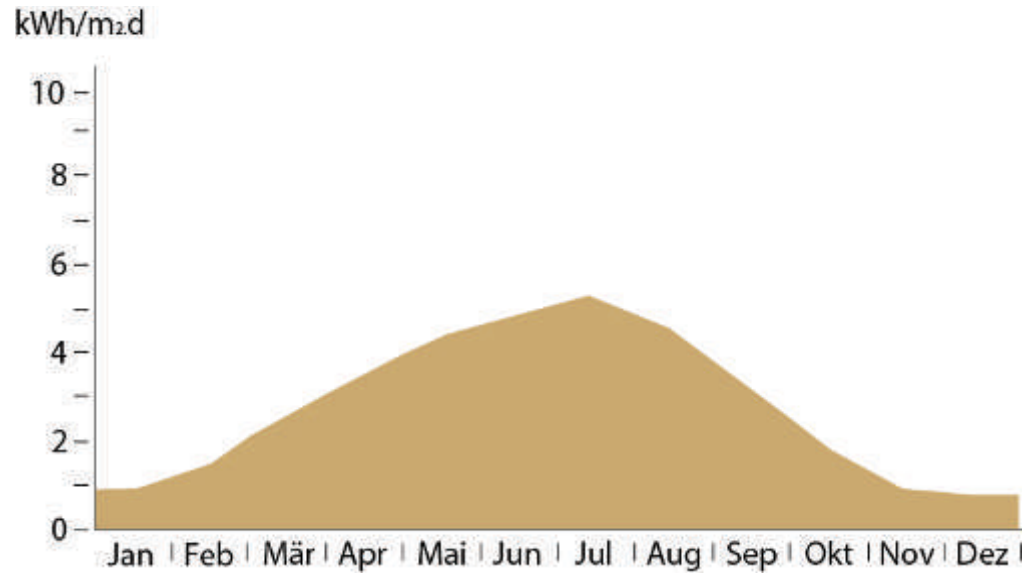
Die Beheizung und Kühlung der Gebäude im Kanton Zürich soll ab dem Jahr 2034 absolut emissionsfrei erfolgen.

Jahr	Emissionsgrenzwert (kg CO ₂ (fossil)/ m ² a)	
	bestehende Anlagen	Neuanlagen
2018	30	12
2022	25	6
2026	20	0
2030	12	0
2034	0	0

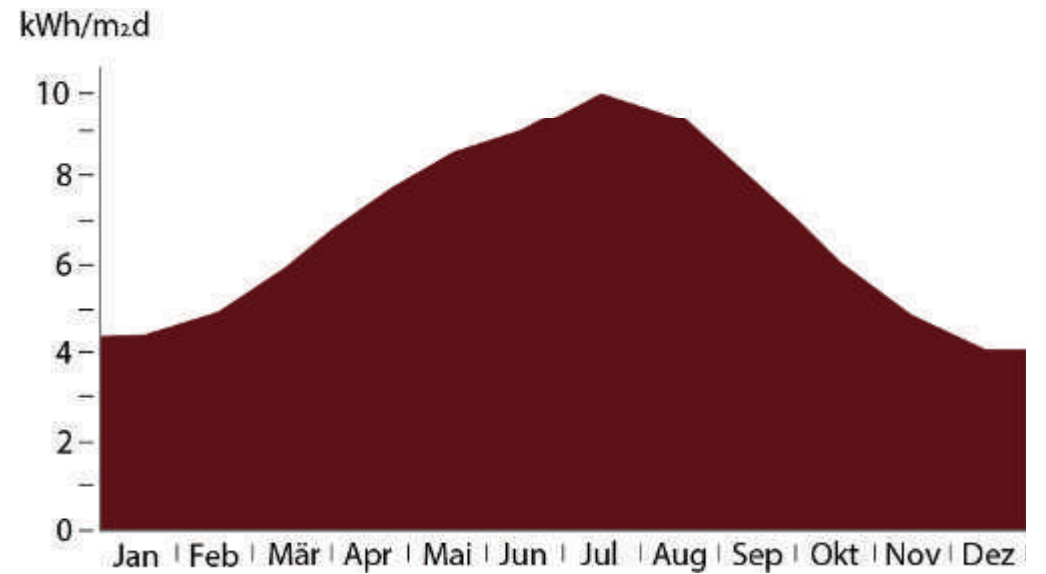
The solar fusion process



Daily solar radiation

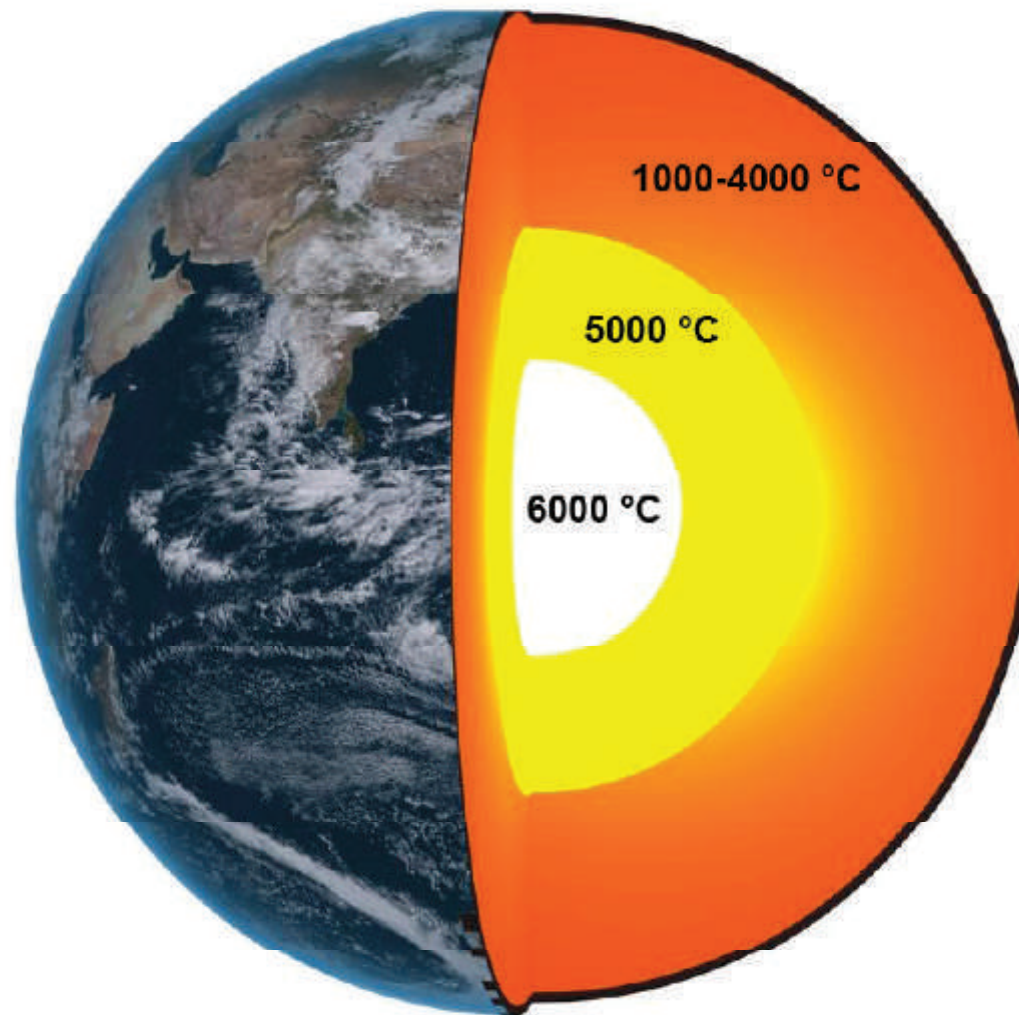


Zurich (Switzerland)

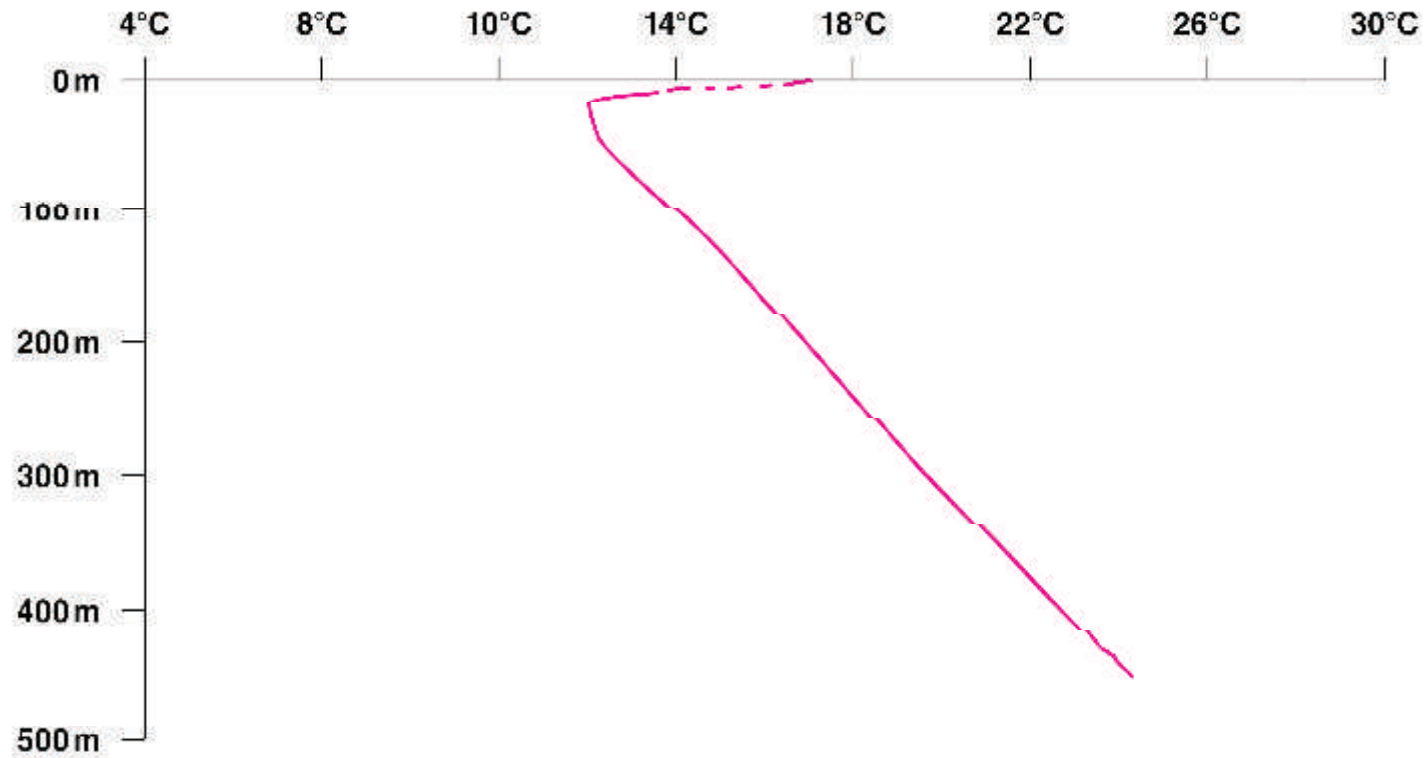


Hueiva (Spain)

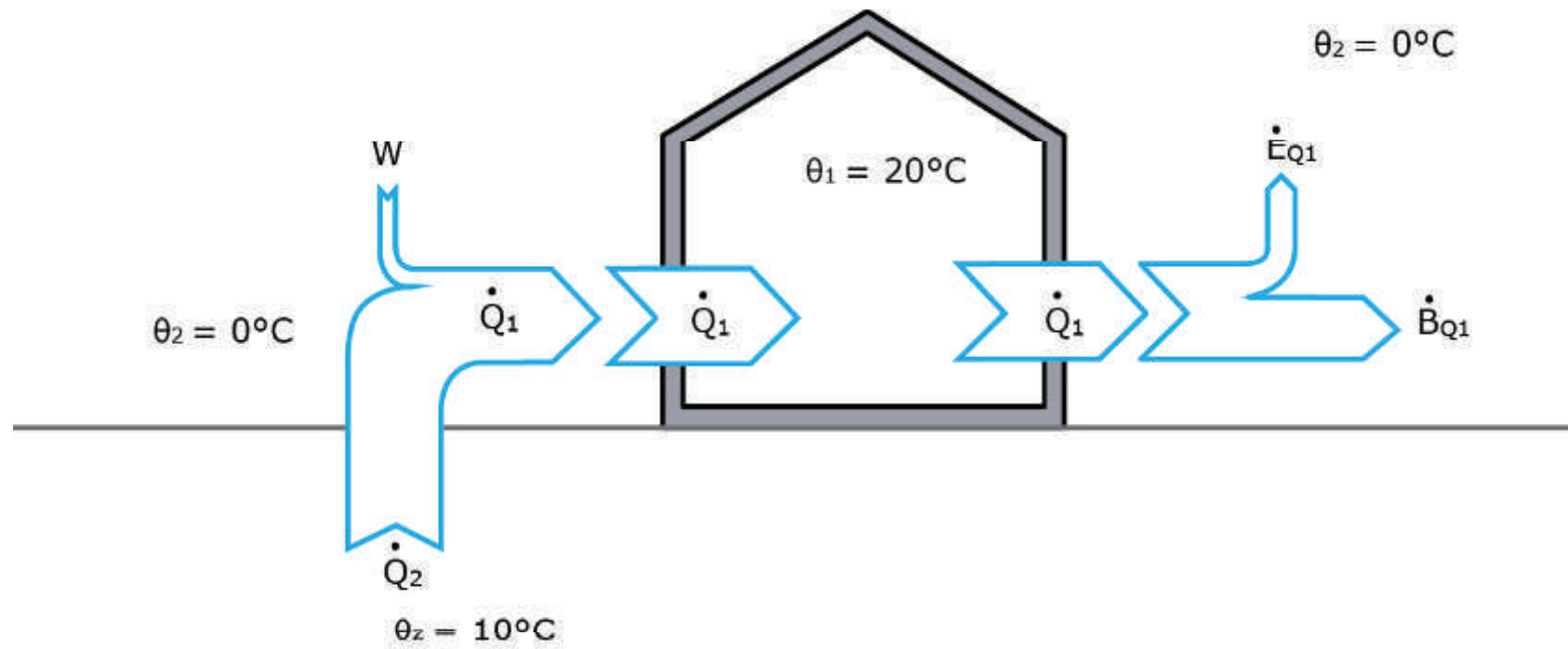
The geothermal process of the earth



Natural ground temperature (Zurich)



1st & 2nd law of Thermodynamics



The quality of the heat pump

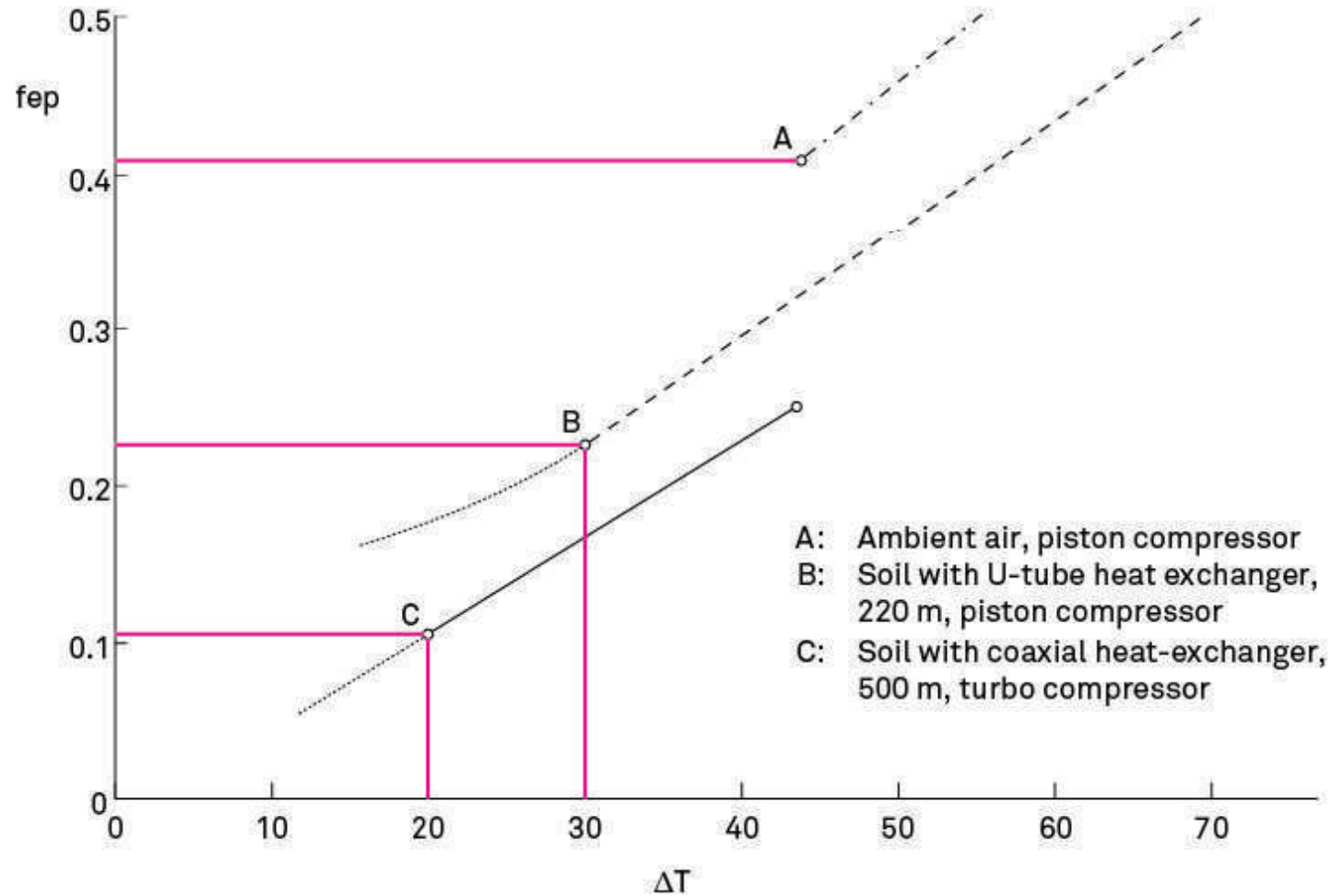
$$\text{COP} = \dot{Q}_1 / W$$

$$\text{COP} = g \cdot T_1 / (T_1 - T_2)$$

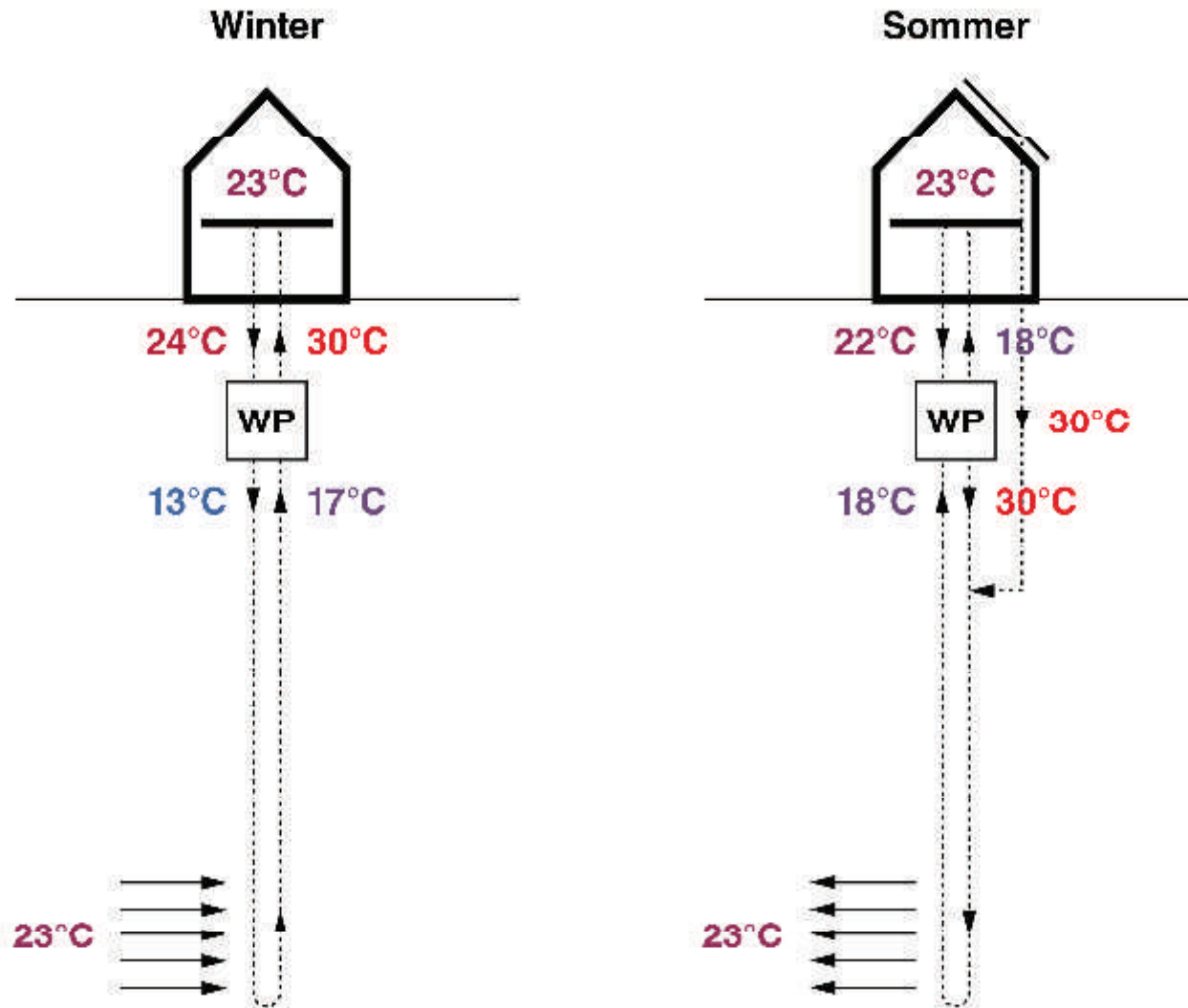
$$\text{fep} = W / \dot{Q}_2$$

$$\text{fep} = (T_1 - T_2) / (g \cdot T_2)$$

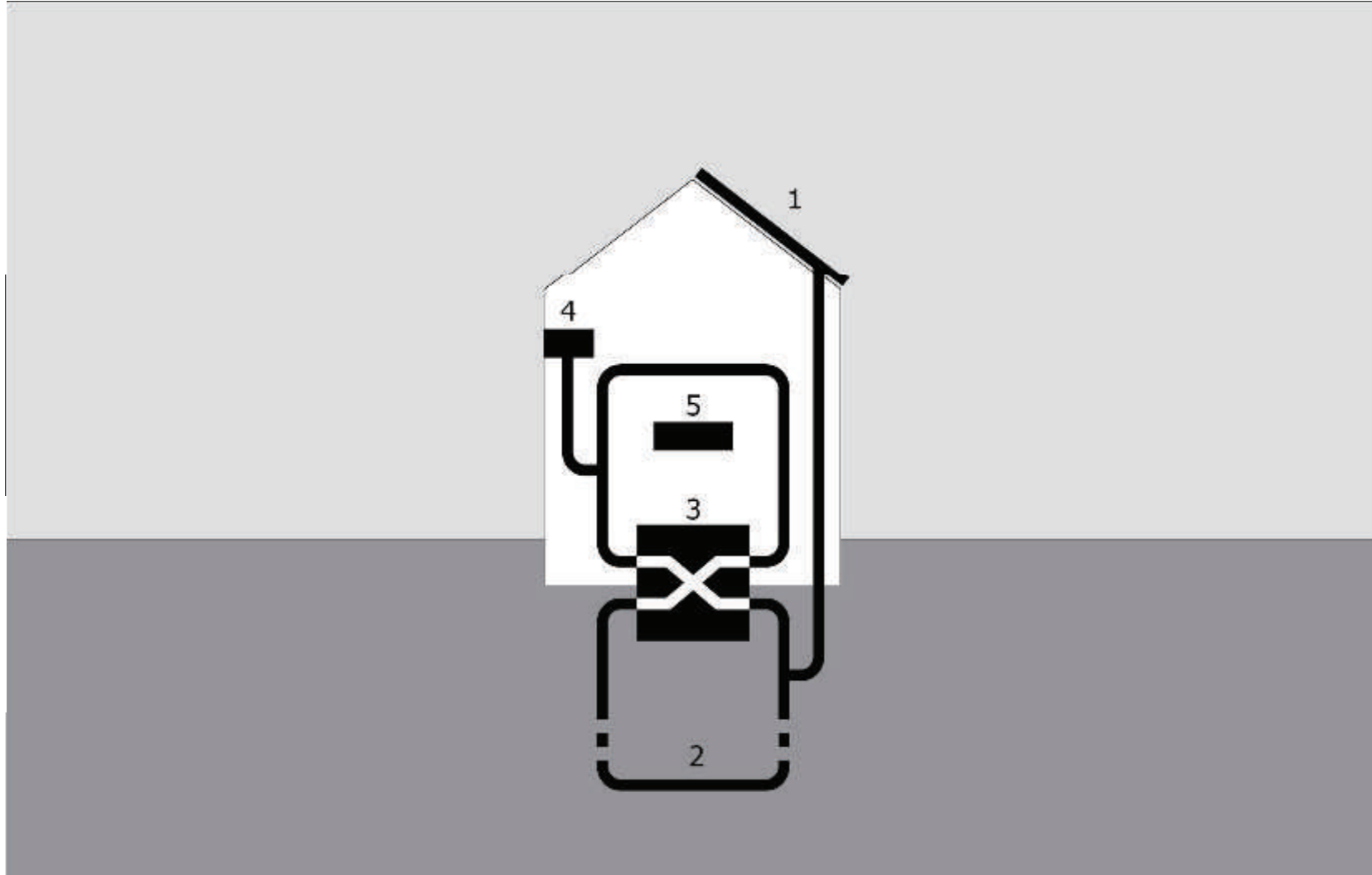
The effect of the heat sources



System 2Sol: heating and cooling



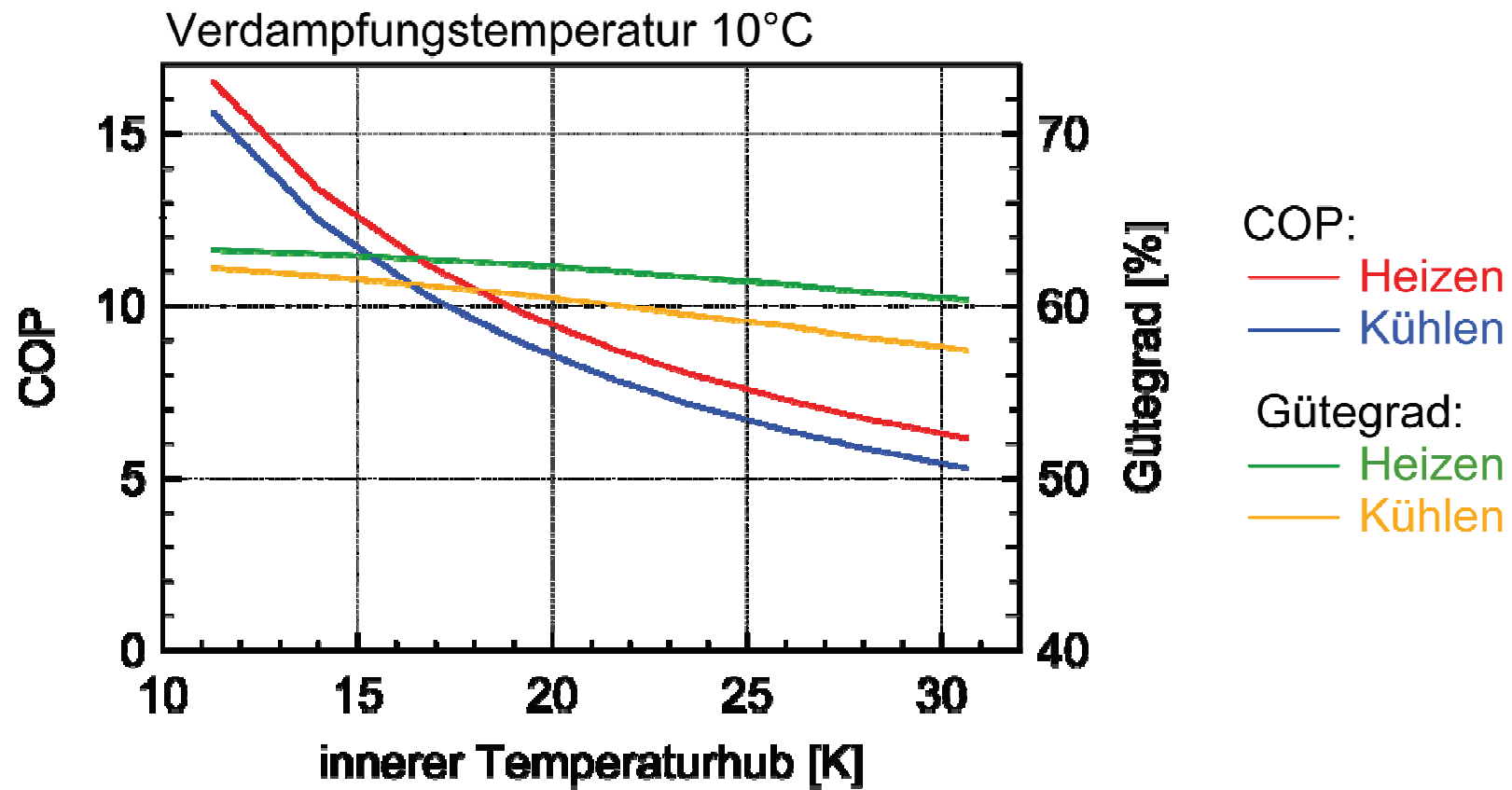
The 2Sol concept



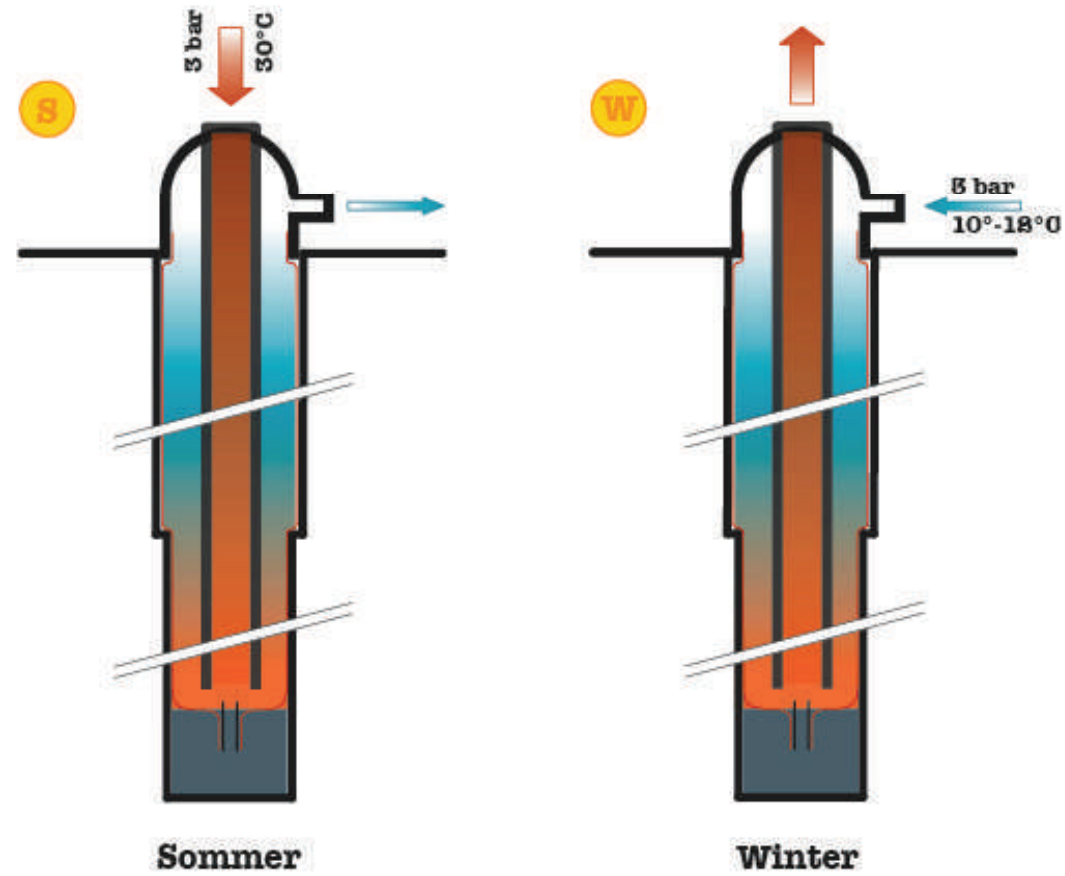
The turbo-compressor heat pump



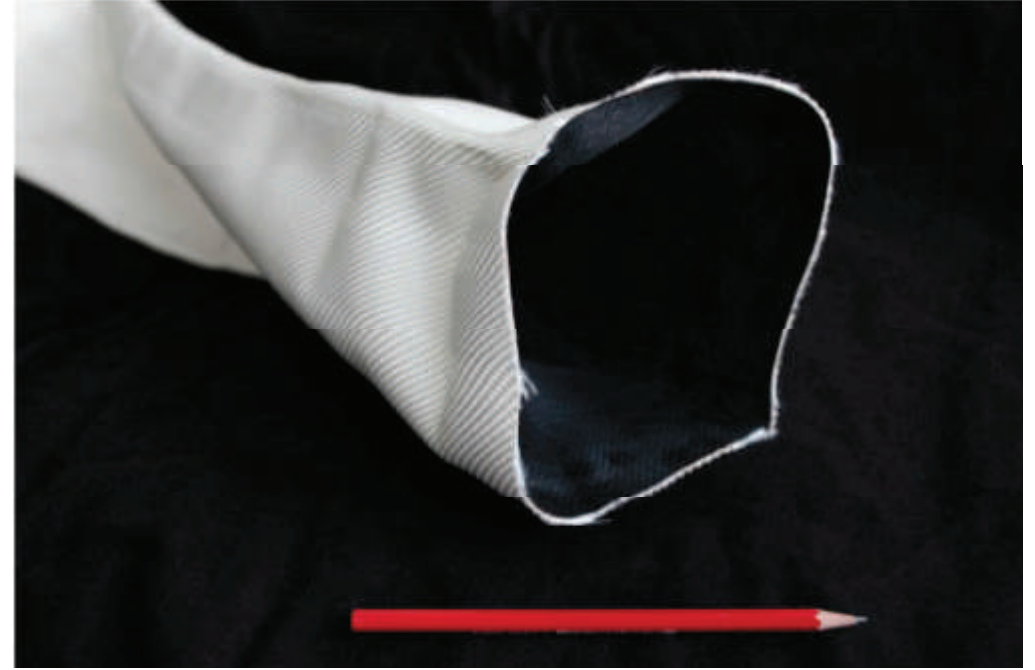
The performance of the turbo-heat pump



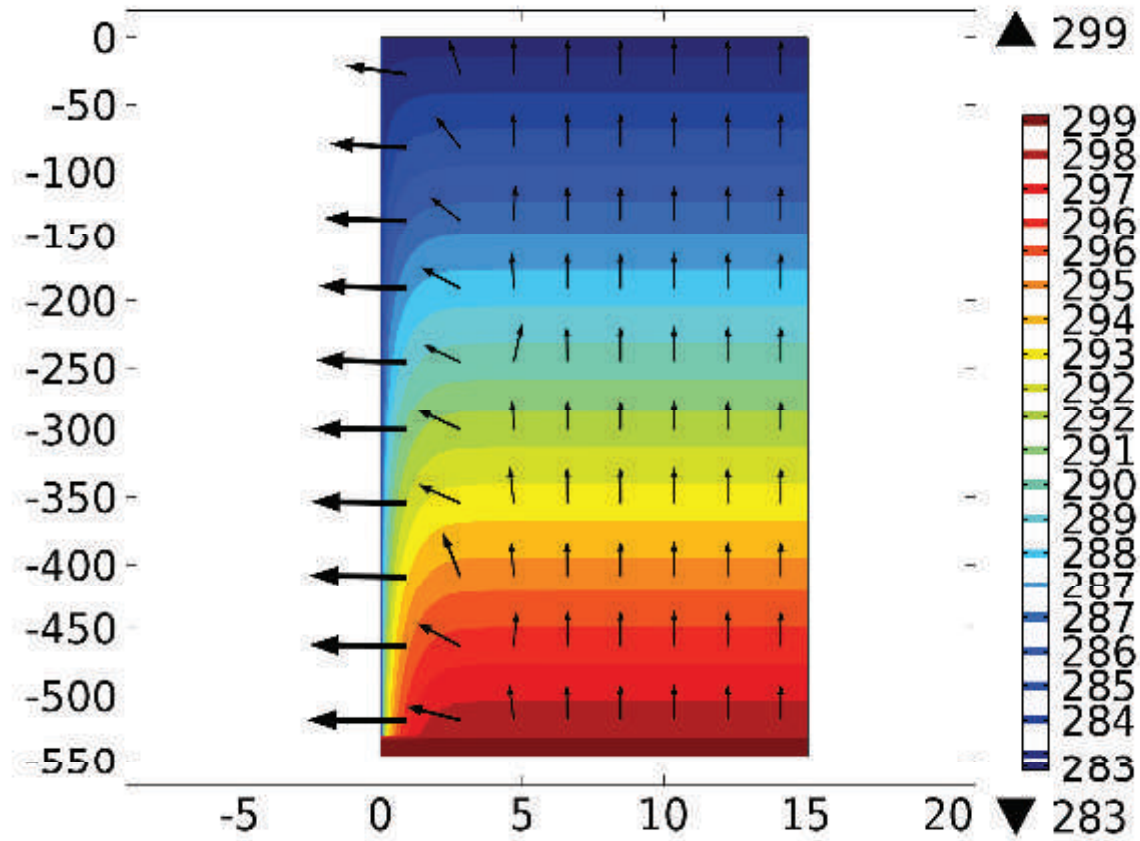
The borehole heat exchanger



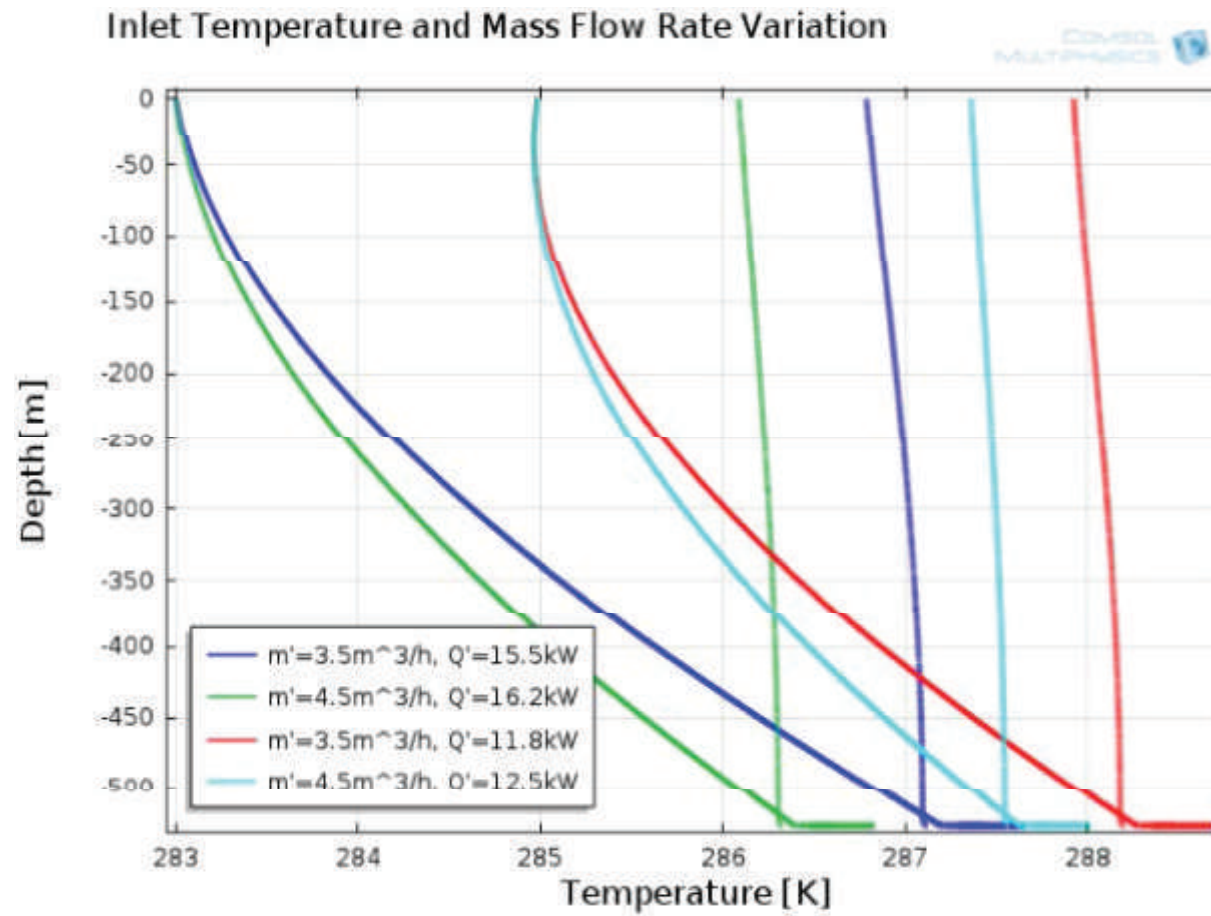
The flexible membrane replacing the U-tube



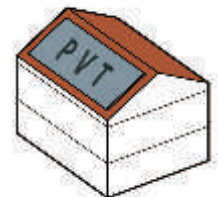
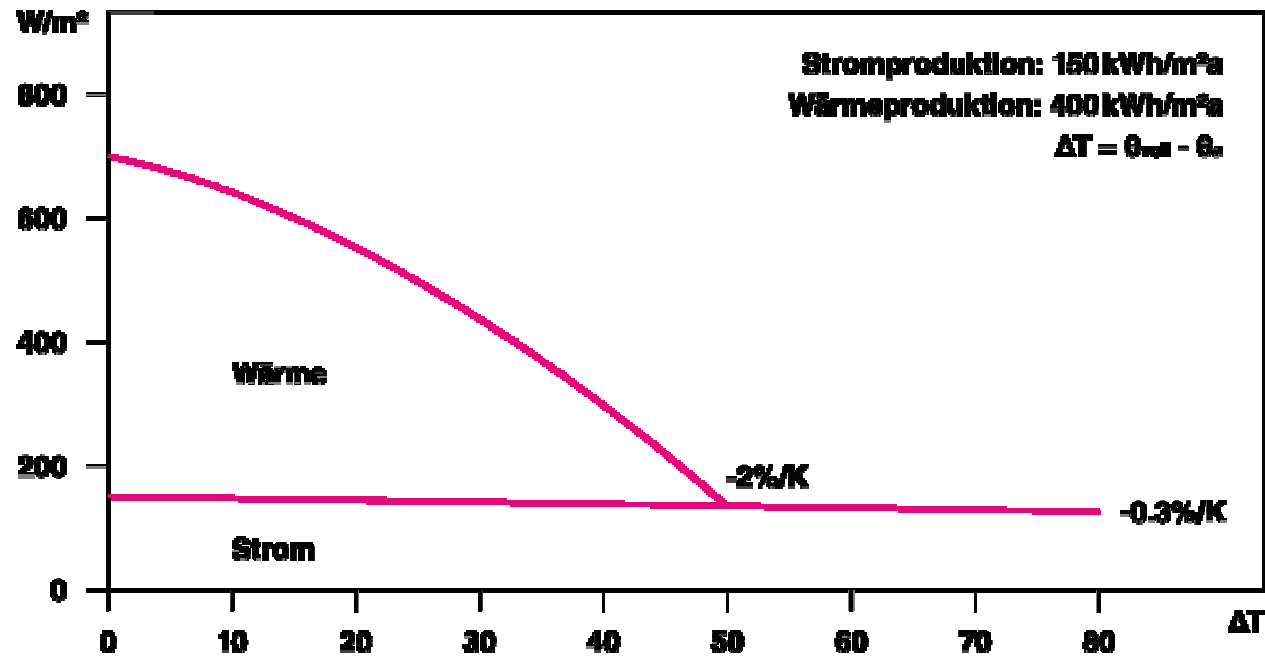
Soil isothermes and temperature gradient after 500 hours



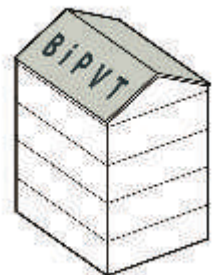
Results with dynamic CFD-Simulation



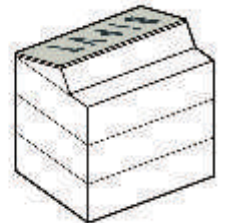
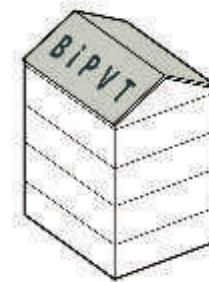
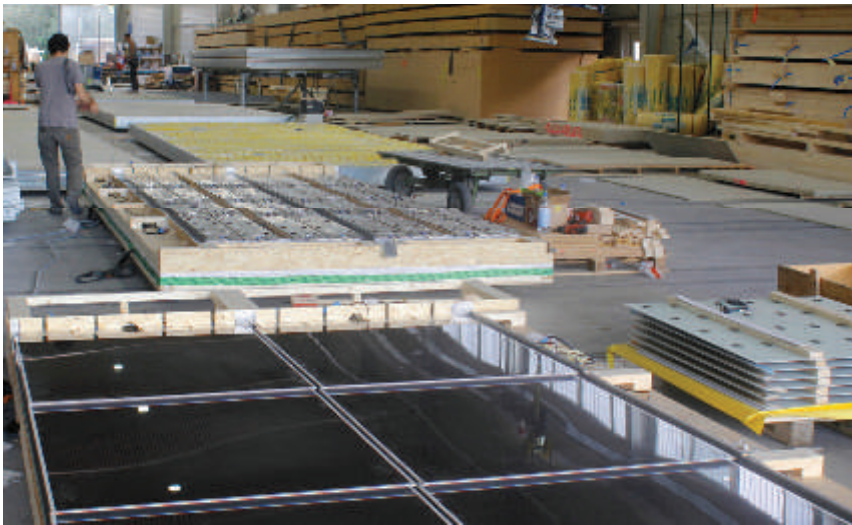
Hybrid solar collector: 1st generation (2011)



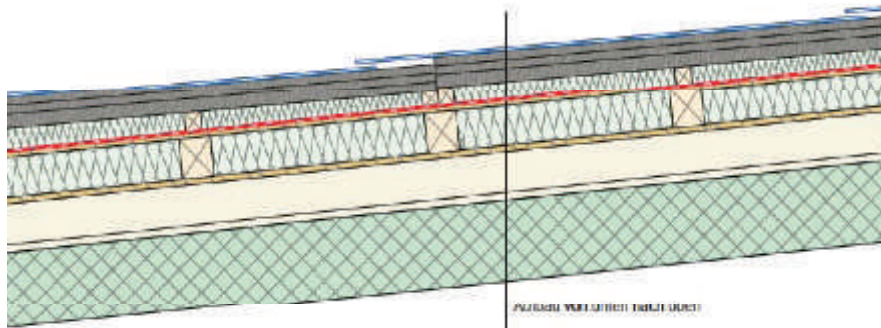
Hybrid solar collector: 2nd generation (2012)



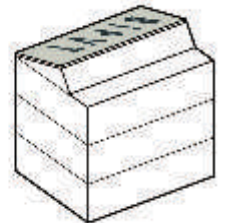
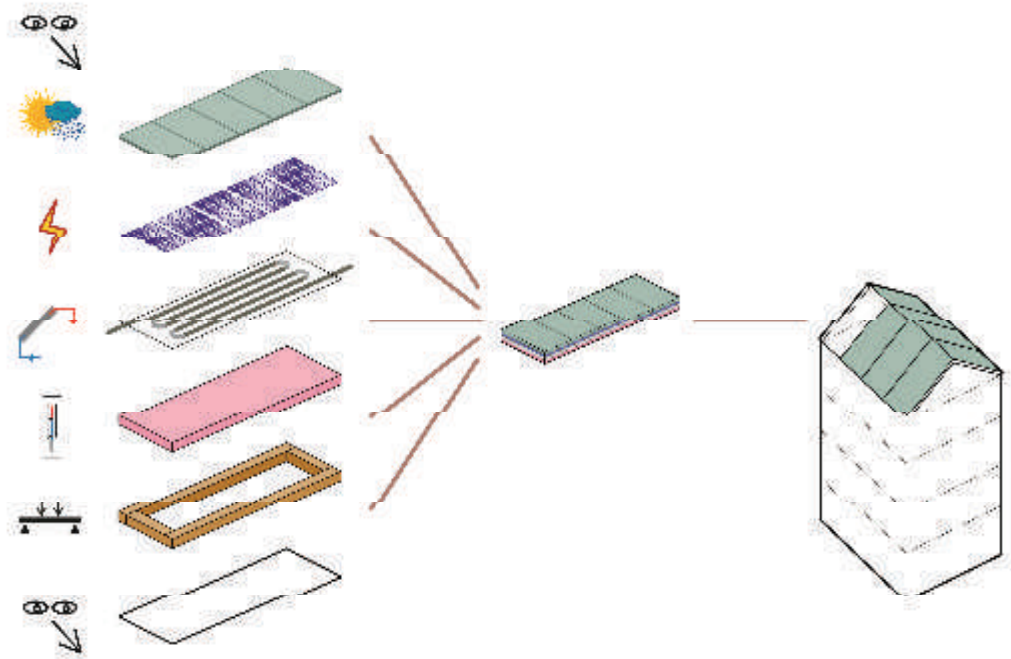
Hybrid solar collector: 3rd generation (2013)



Hybrid solar collector: roof integration



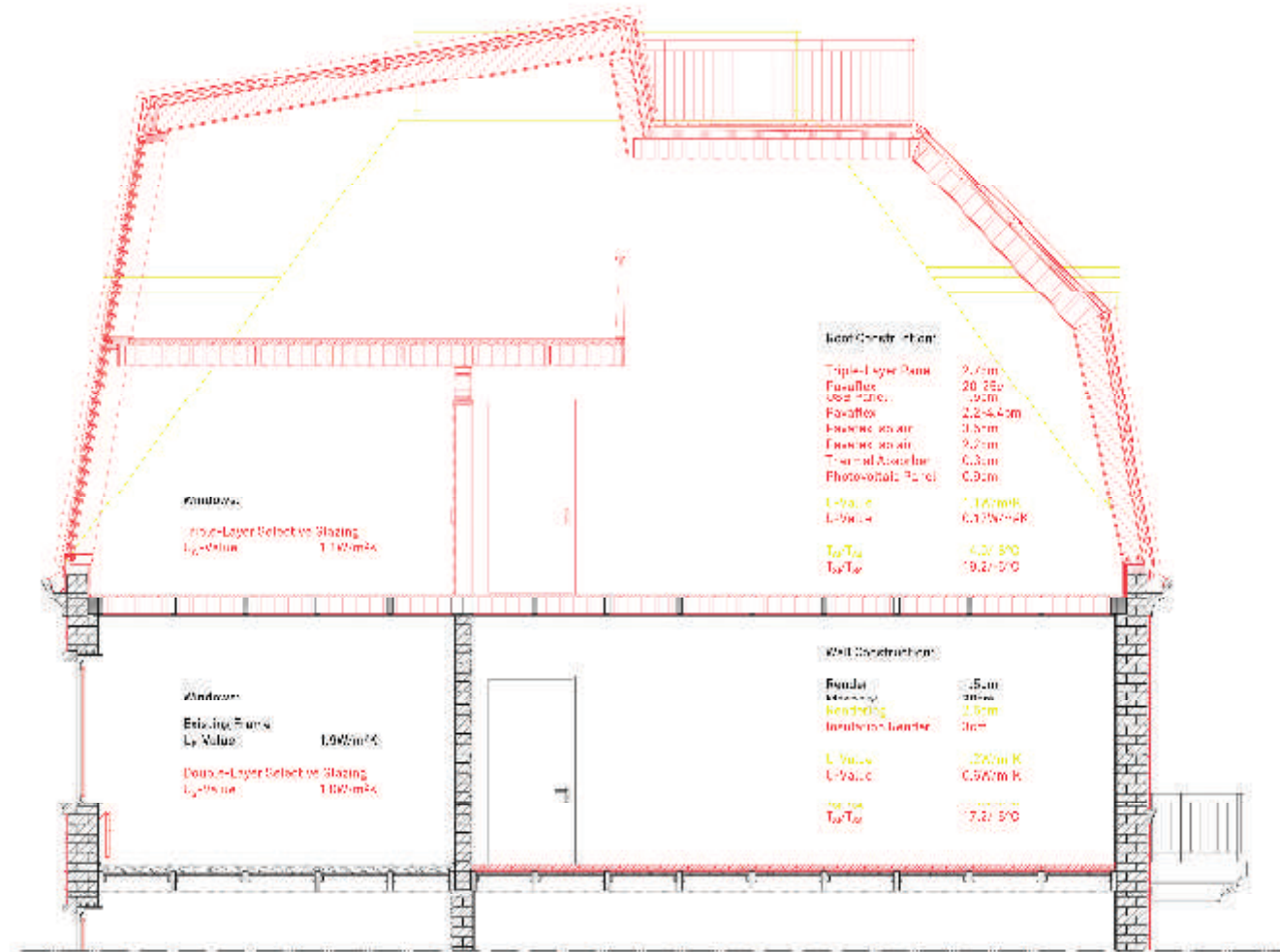
OSB-3 15mm
 Konstruktionsholz DUO mit C24 80/100
 Pavaflex h=100mm
 OSB-3 15 mm
 Dampfsperre
 Ausgleichschicht Pavaflex h= 60mm
 Ausgleichschicht Latten C24 40/40, 49/40, 56/40mm
 Isolschicht 30mm
 Isolair b=400mm h=22mm
 Isolastreifen b=100mm h=22mm
 Absorbierendes PV's
 PV's



1920s building: vertical extension & energetic improvement



1920s building: construction detail



The building in it's architectural environment



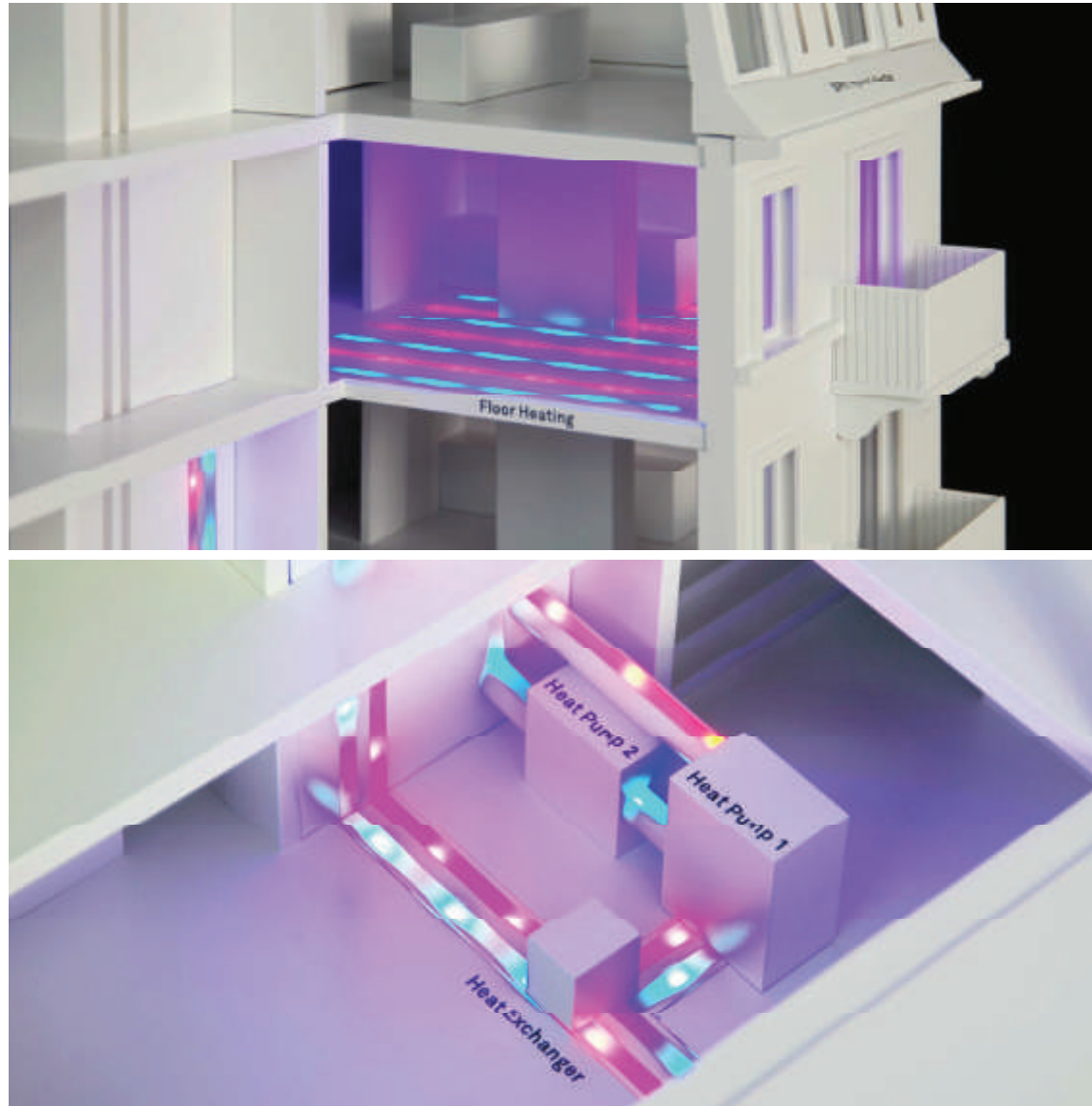
Siteplan



Scheme of operation: harvesting & storing

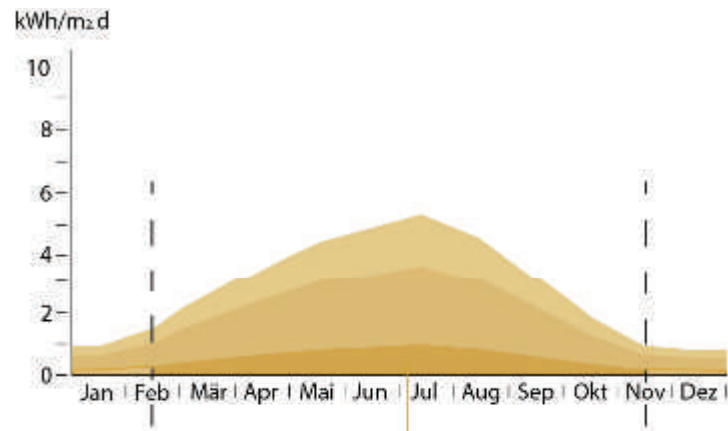


Scheme of operation: heat transformation

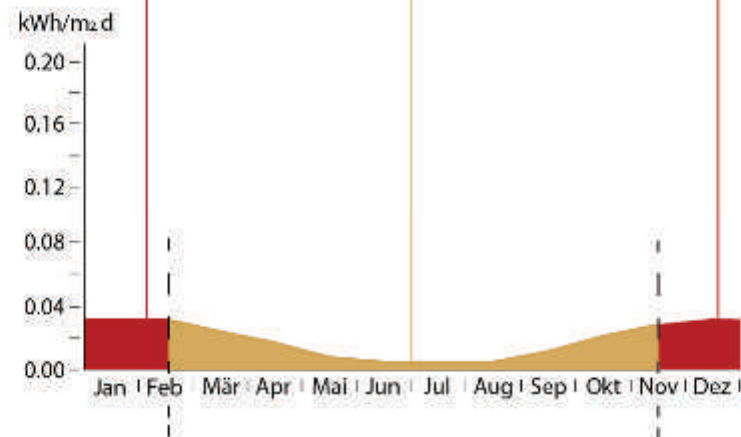
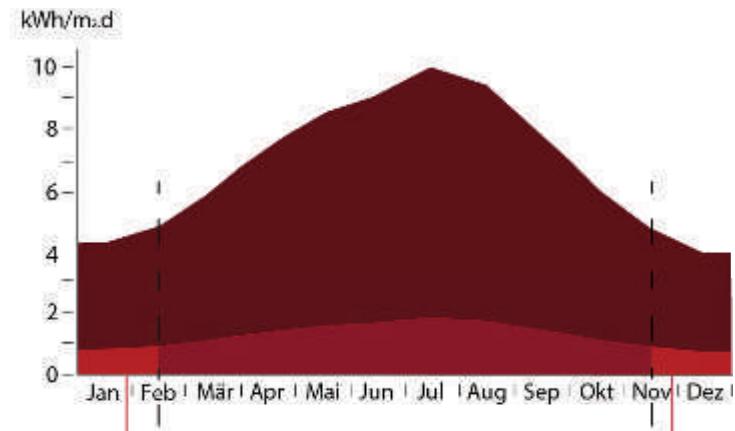


Connecting Zurich with Huelva

Electrical power production in Zurich



Electrical power production in Huelva



Electrical power demand in Zurich

The continental system



Regreening the Mediterranean coast

