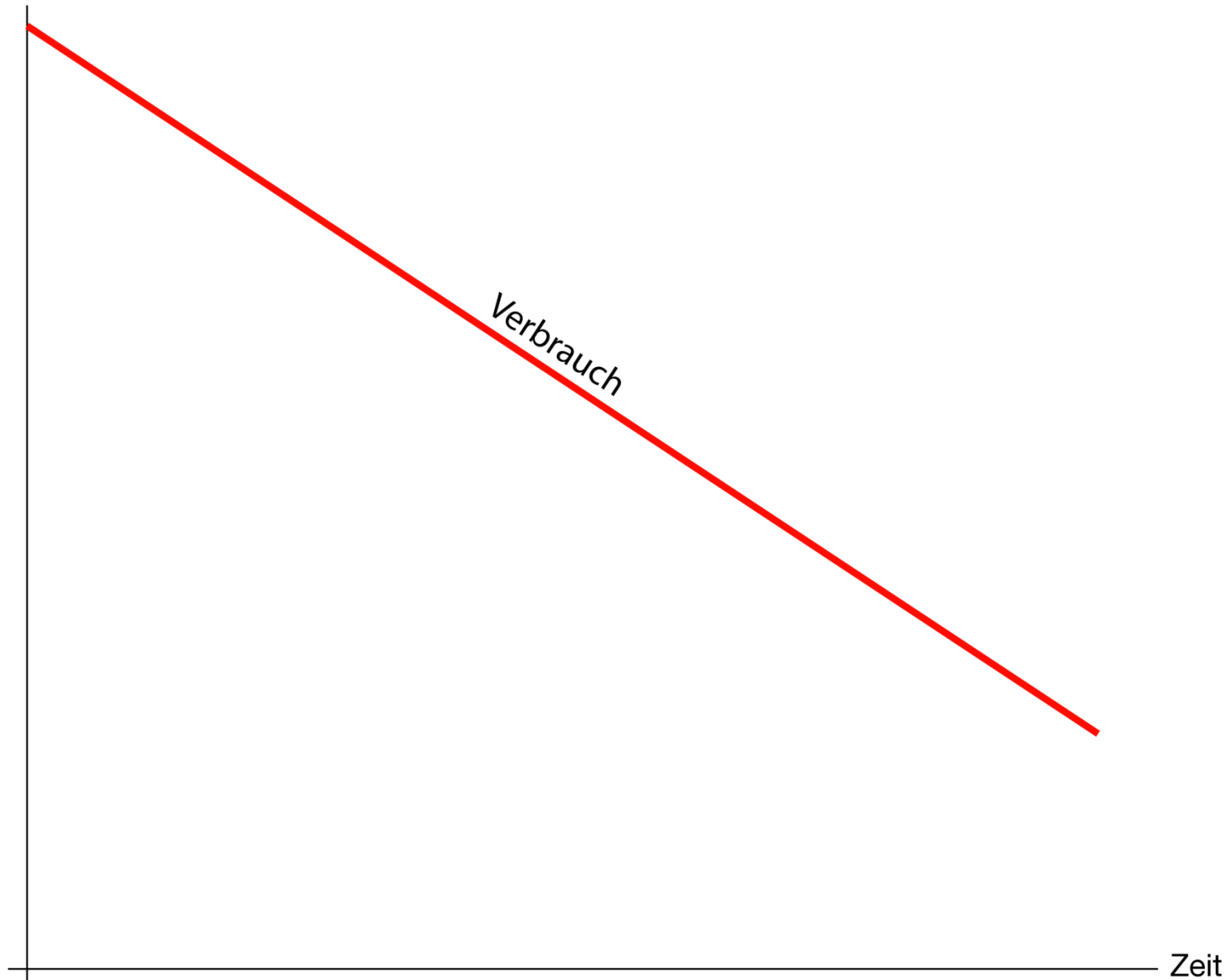
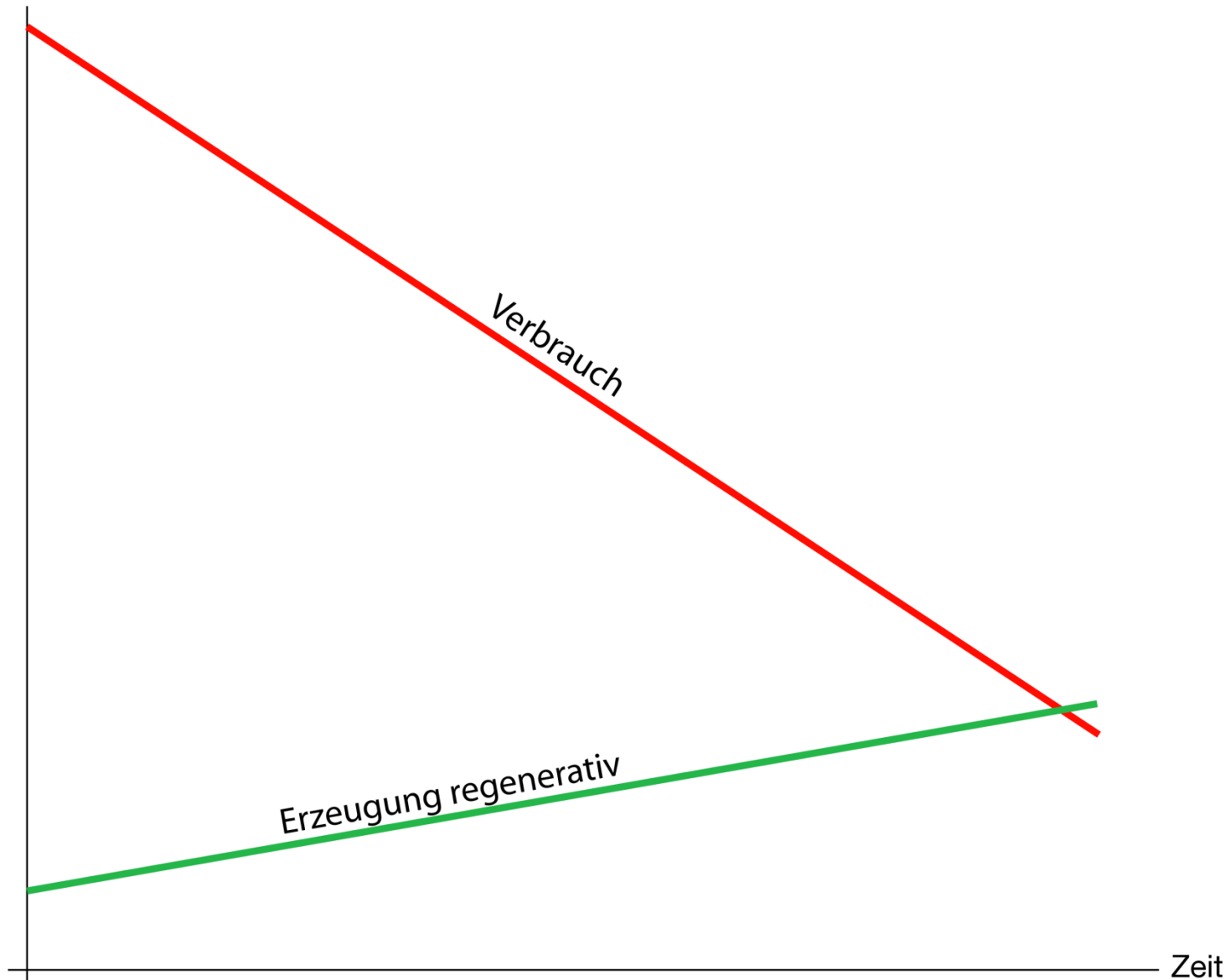




Energie



Energie







Heliotrop - Rolf Disch



Plusenergiegebäude - Solar Decathlon  
TU Darmstadt 2008 / 2009



Plusenergiegebäude Berlin  
Werner Sobek 2011



Aktiv - Stadthaus Frankfurt







Systemgrenzen festlegen

# Energie

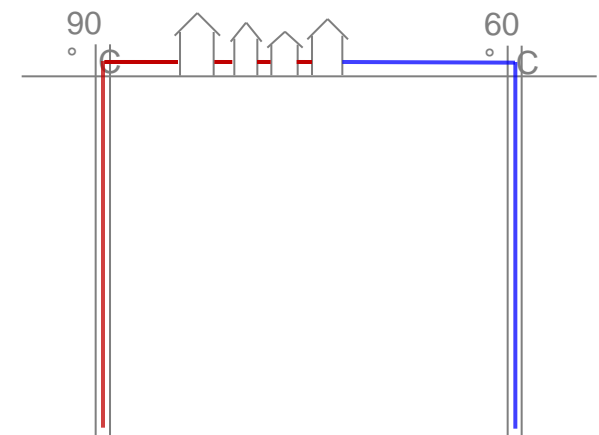
Energie

Energie  Exergie (Wertigkeit)

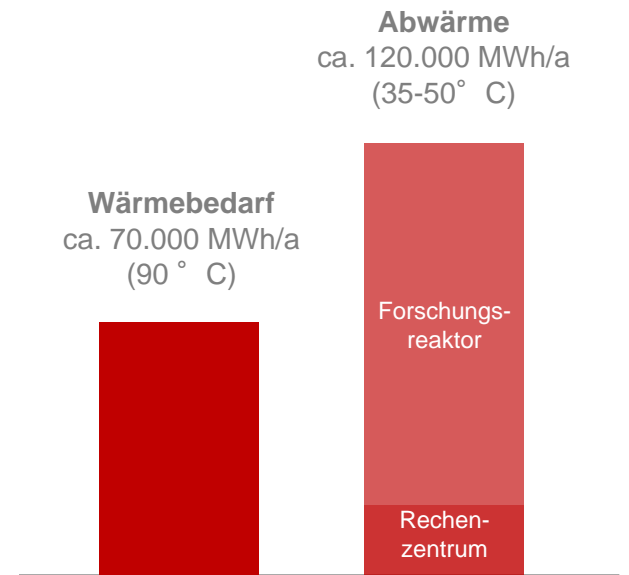
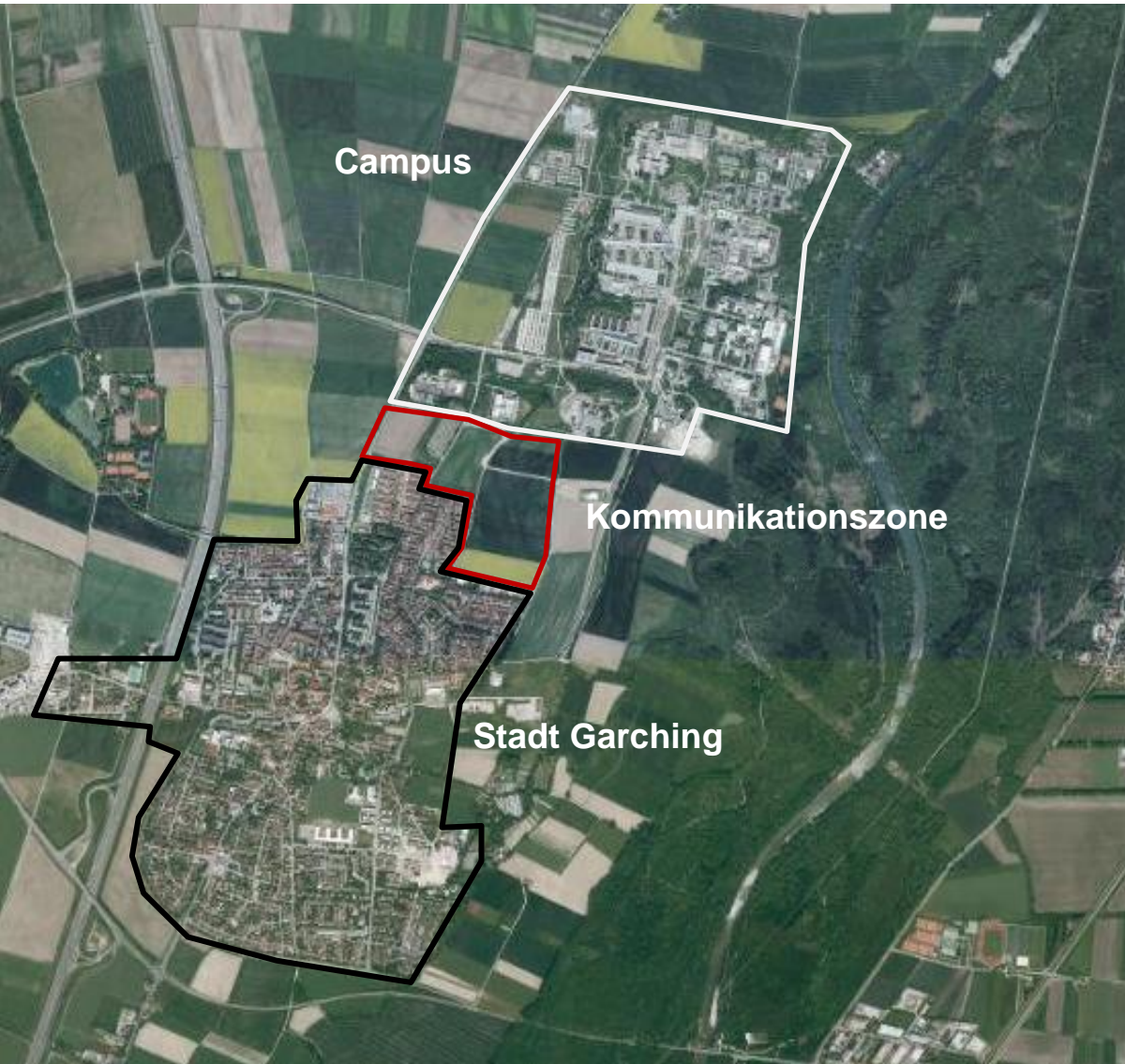
Energie

Energie  Exergie (Wertigkeit)

Energie  Verfügbarkeit von Energie



Wertigkeit der Energie



Ordinariat München

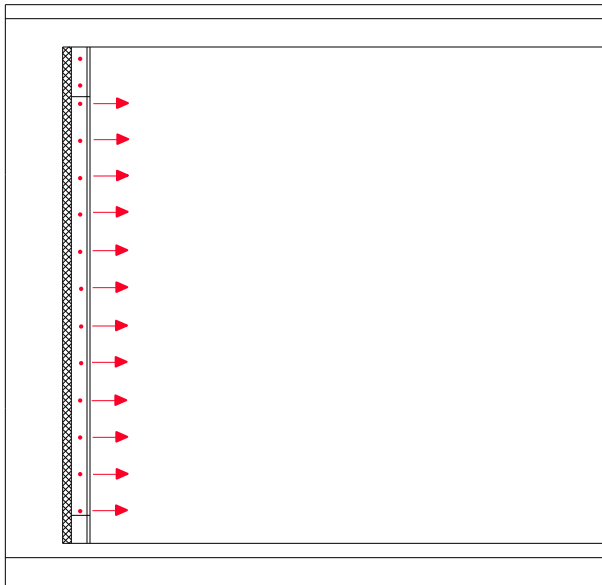




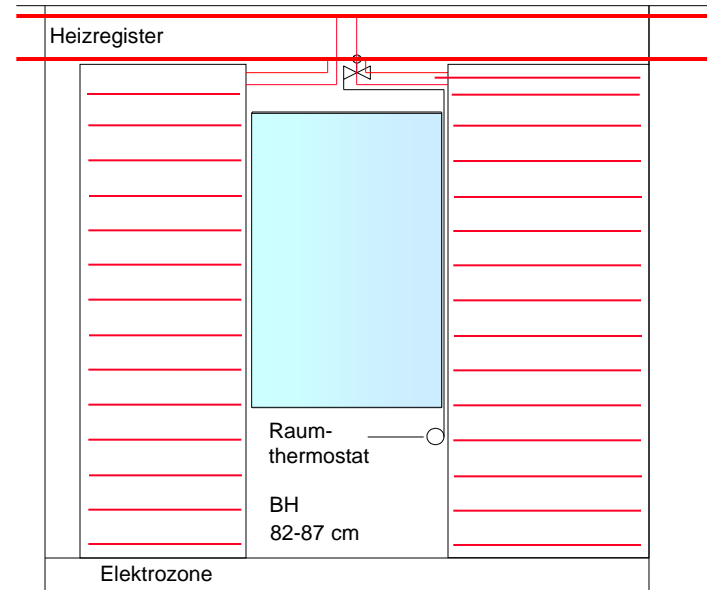




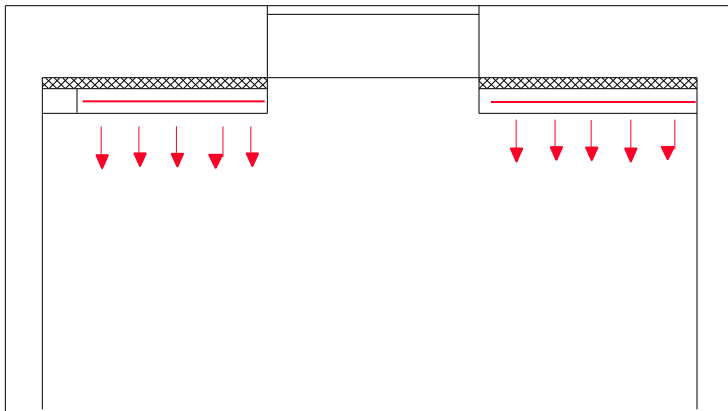




Schnitt - Wandheizsystem



Ansicht - Innenwand mit Wandheizsystem



Grundriss - Wandheizsystem

Vorlauftemperatur

90°C

40°C

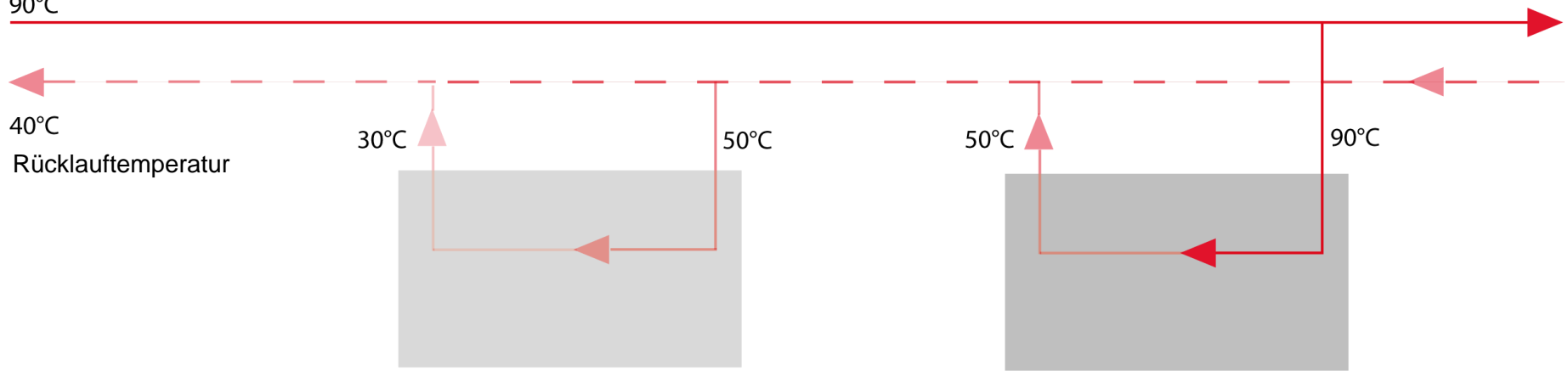
Rücklauftemperatur

30°C

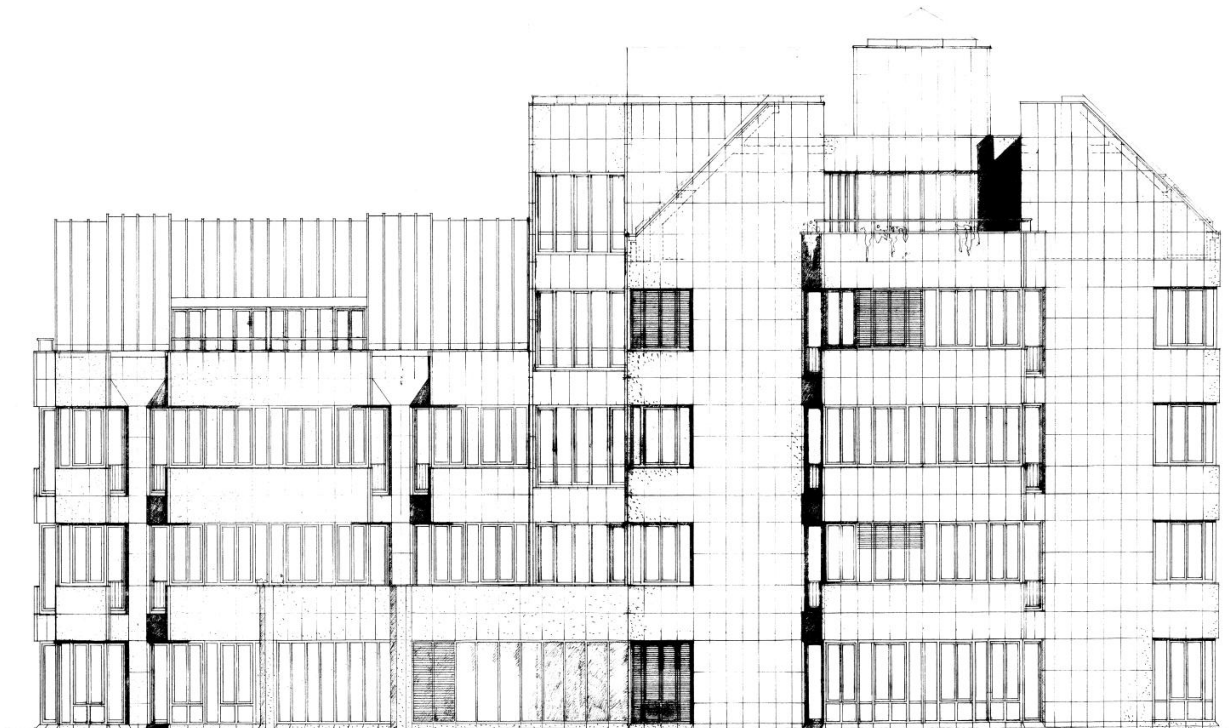
50°C

50°C

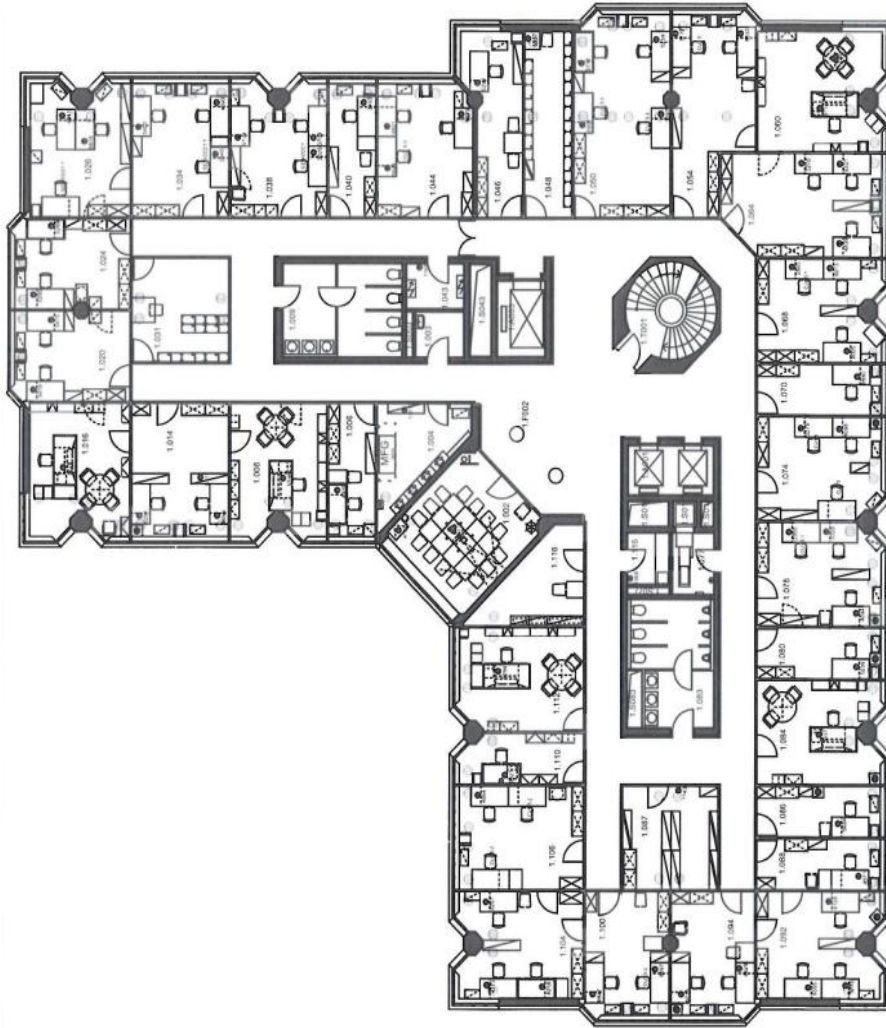
90°C

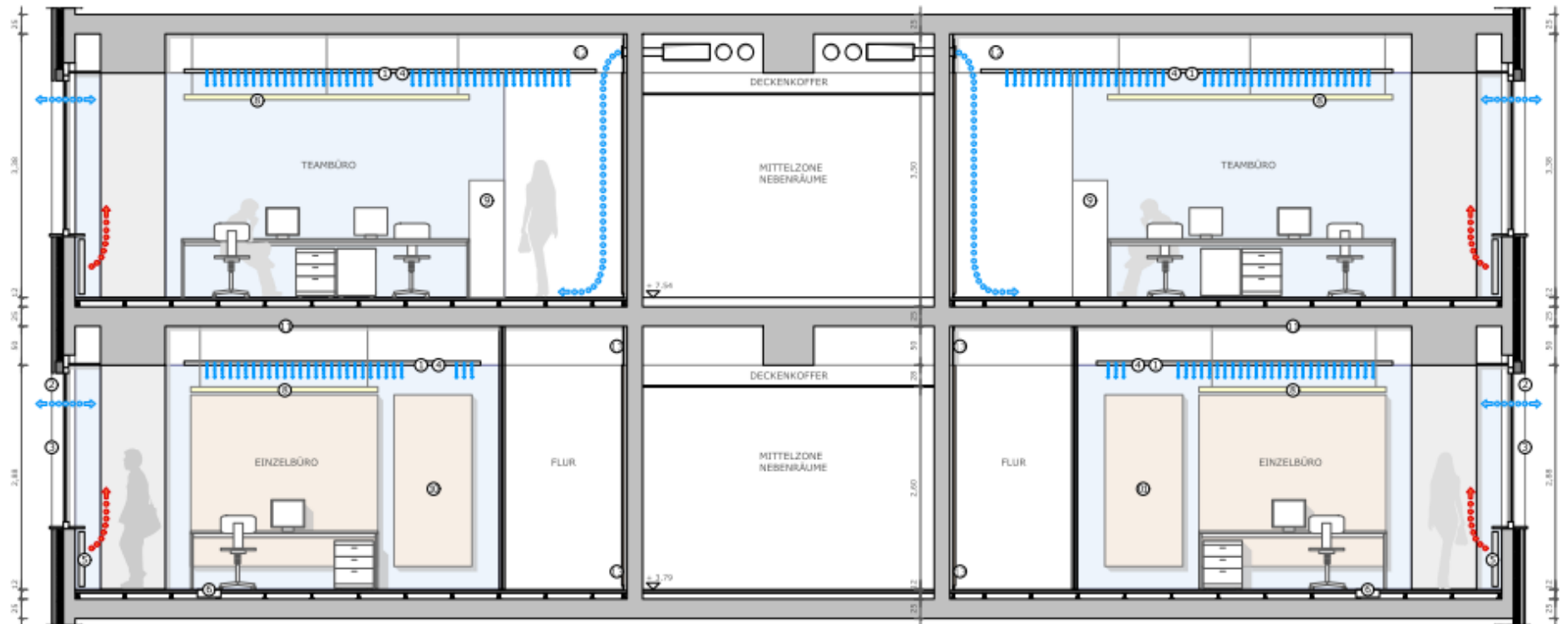


## Sanierung Verwaltungsgebäude München





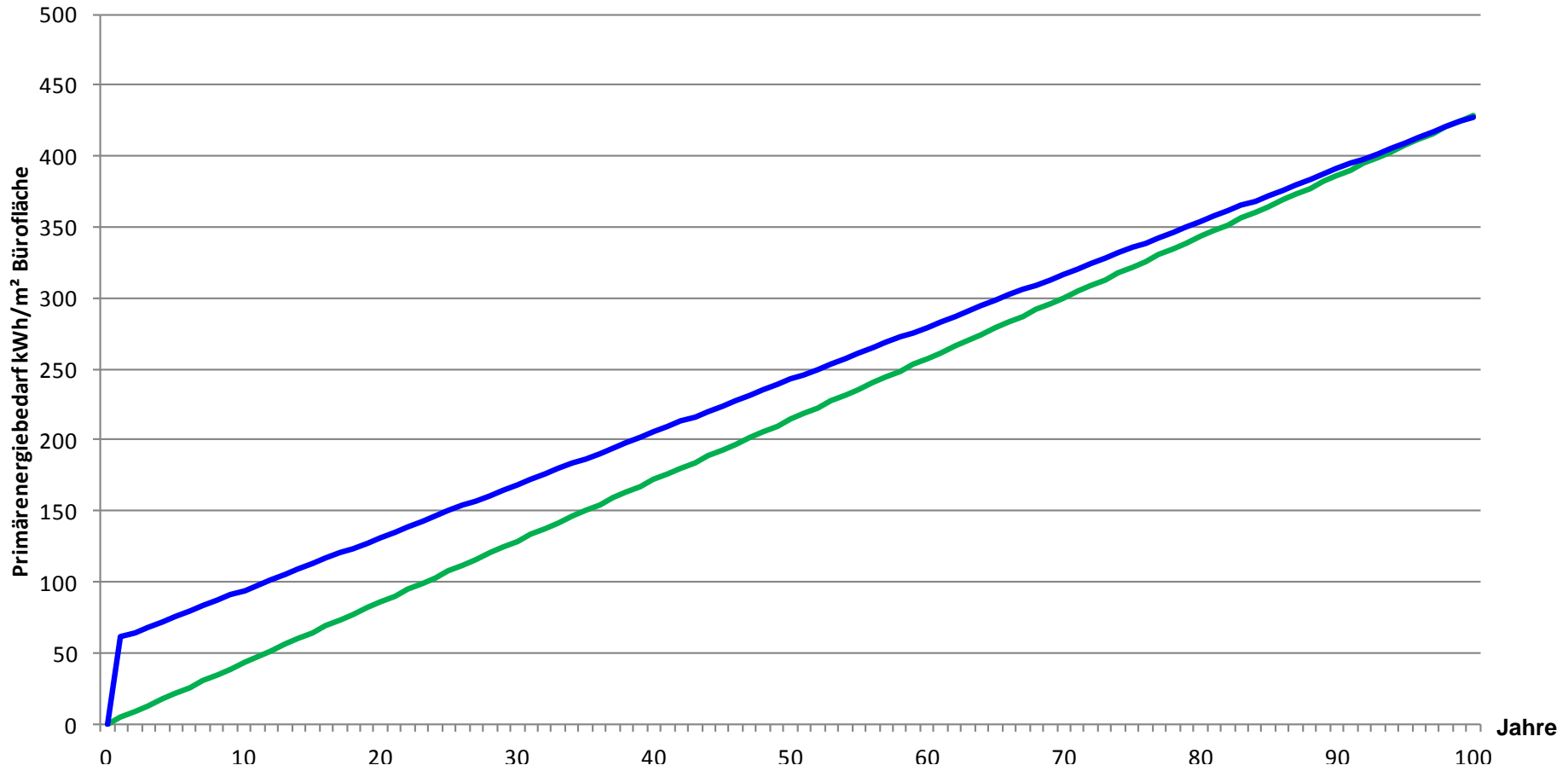




Schnitt neue Haustechnik

## Kumulierter Primärenergiebedarf

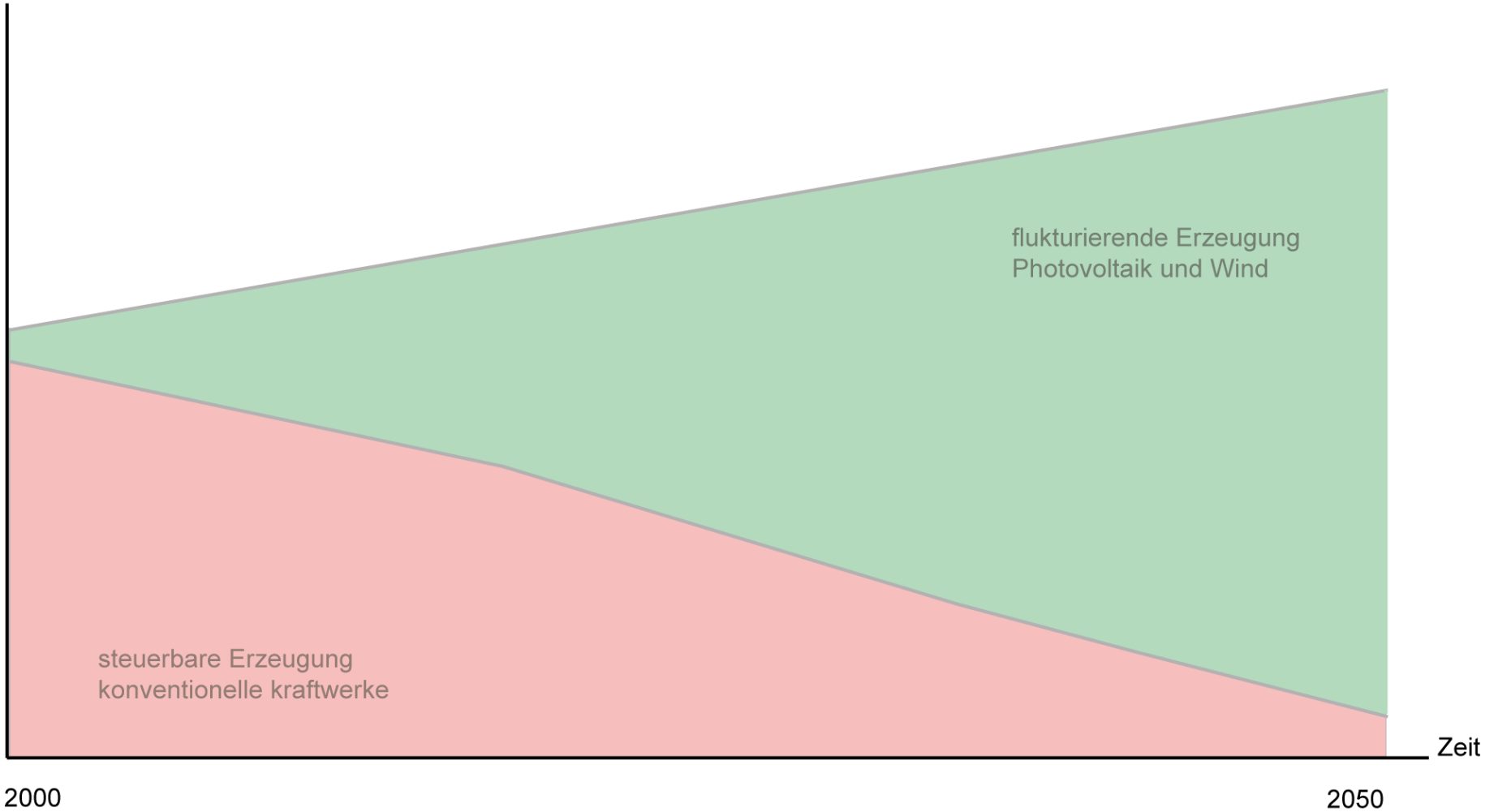
— ohne neue Aussenwanddämmung      — mit neuer Aussenwanddämmung



Vergleich der Sanierungsvariante

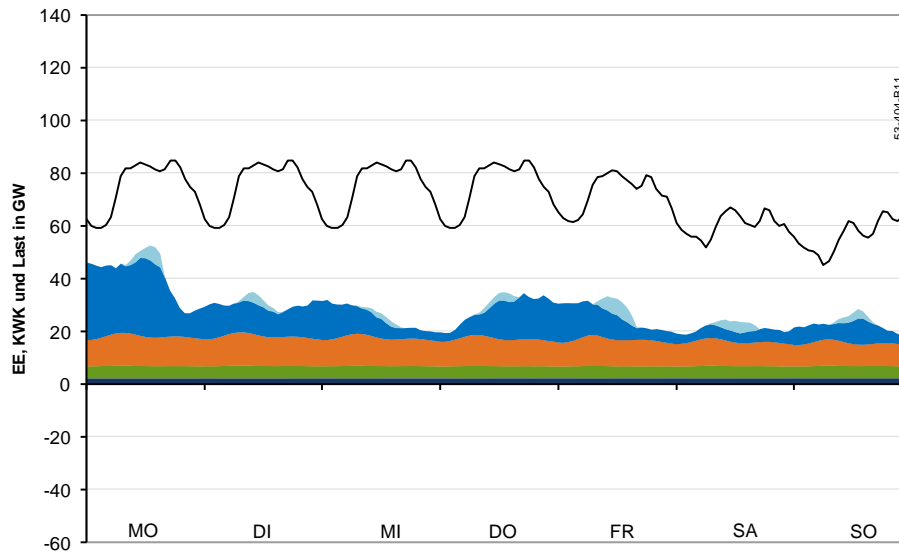
## Zeitliche Verfügbarkeit von Energie - Lastverläufe

## Kraftwerksleistung

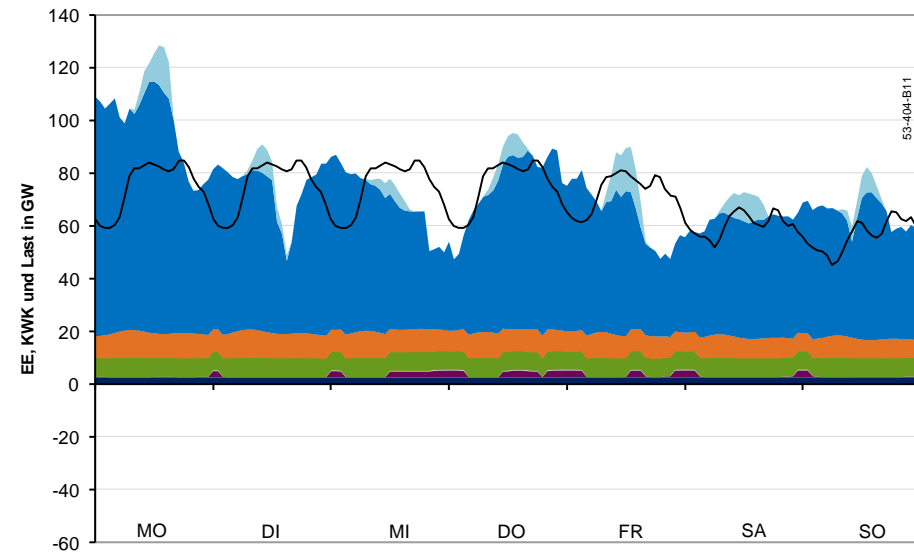


Entwicklung der Stromerzeugung

### Stromverbrauch / Stromerzeugung heute - Winter

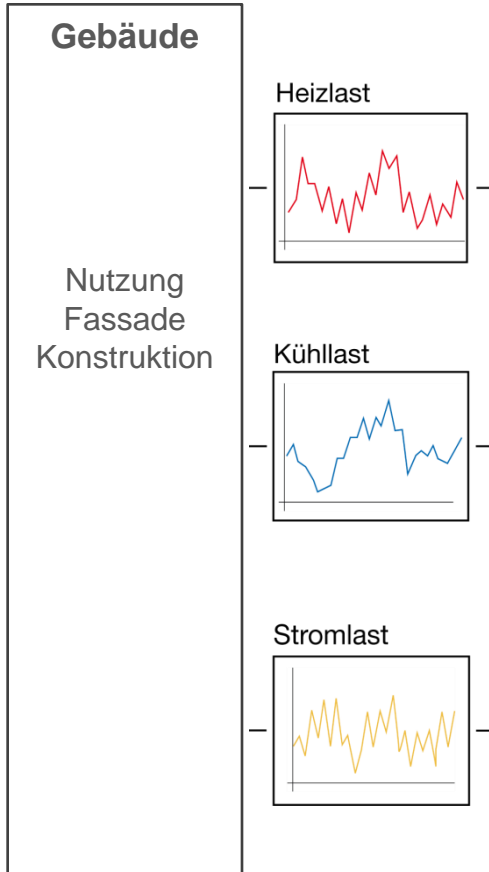


### Stromverbrauch / Stromerzeugung zukünftig - Winter



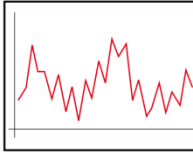
[Kuhn, 2011, IfE]

- Photovoltaik
- Wind
- KWK
- Biomasse
- Geothermie
- Laufwasser
- Lastverlauf Bedarf
- resultierender Lastverlauf konventionelle Erzeugung

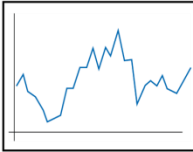




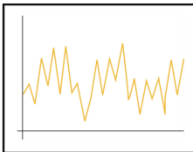
Heizlast



Kühllast



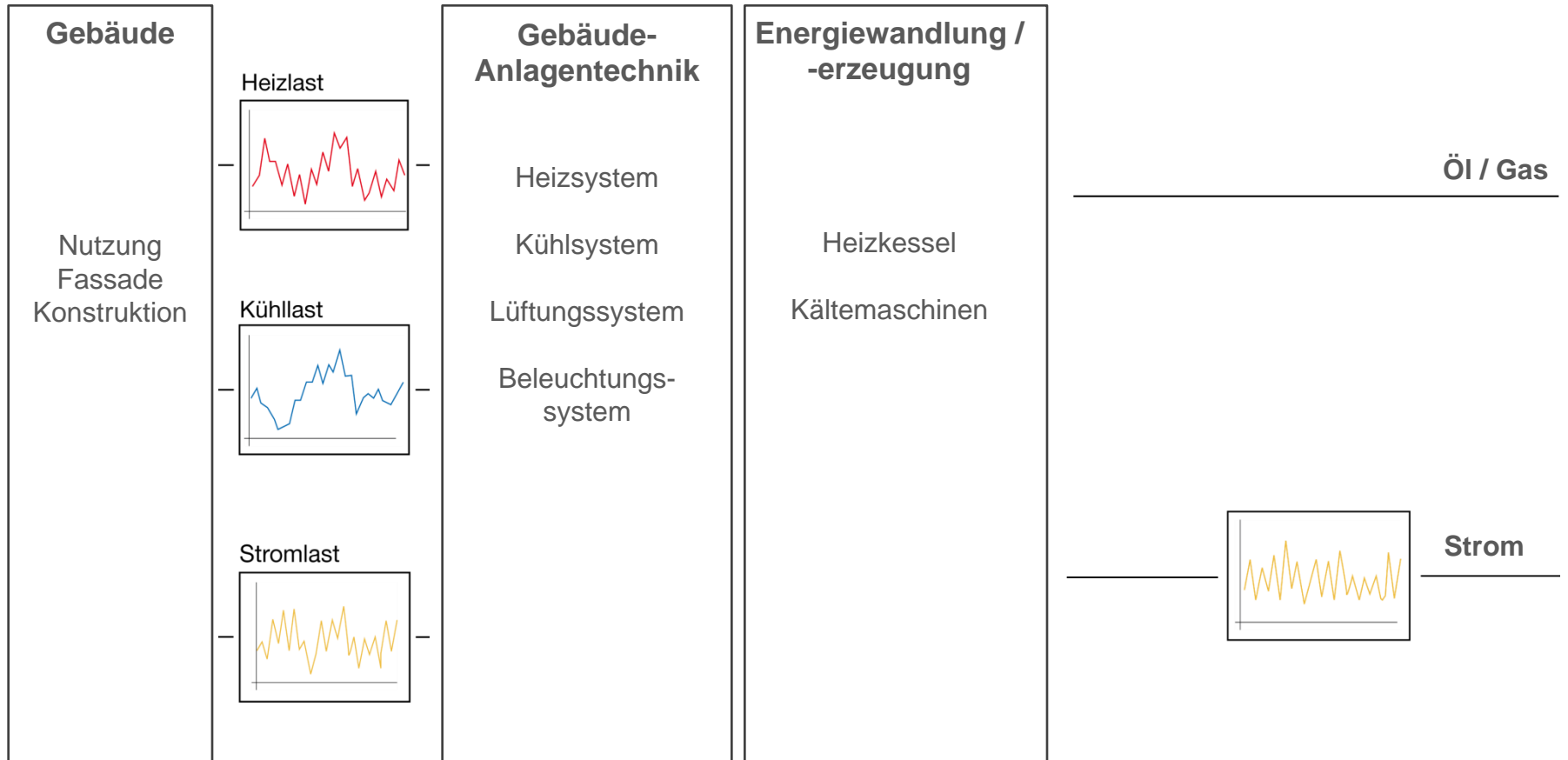
Stromlast

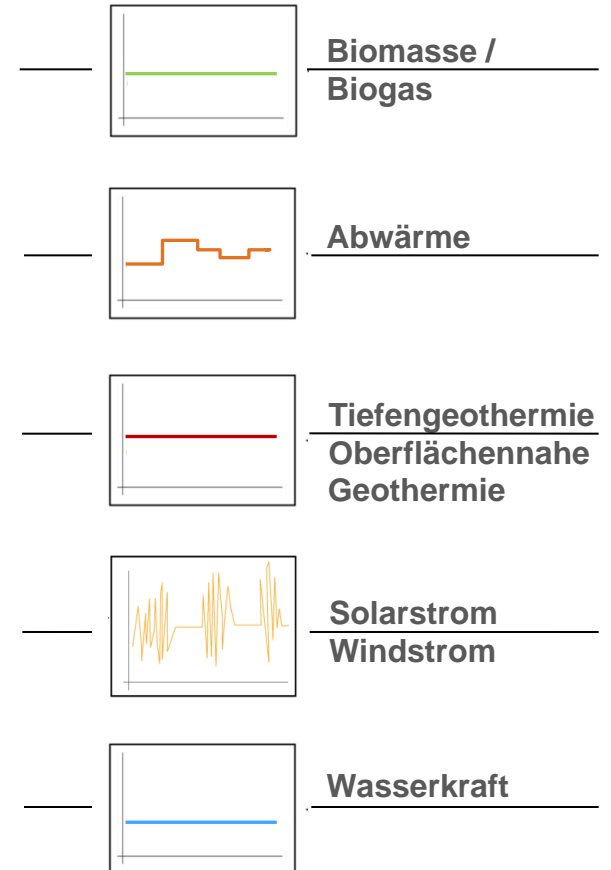


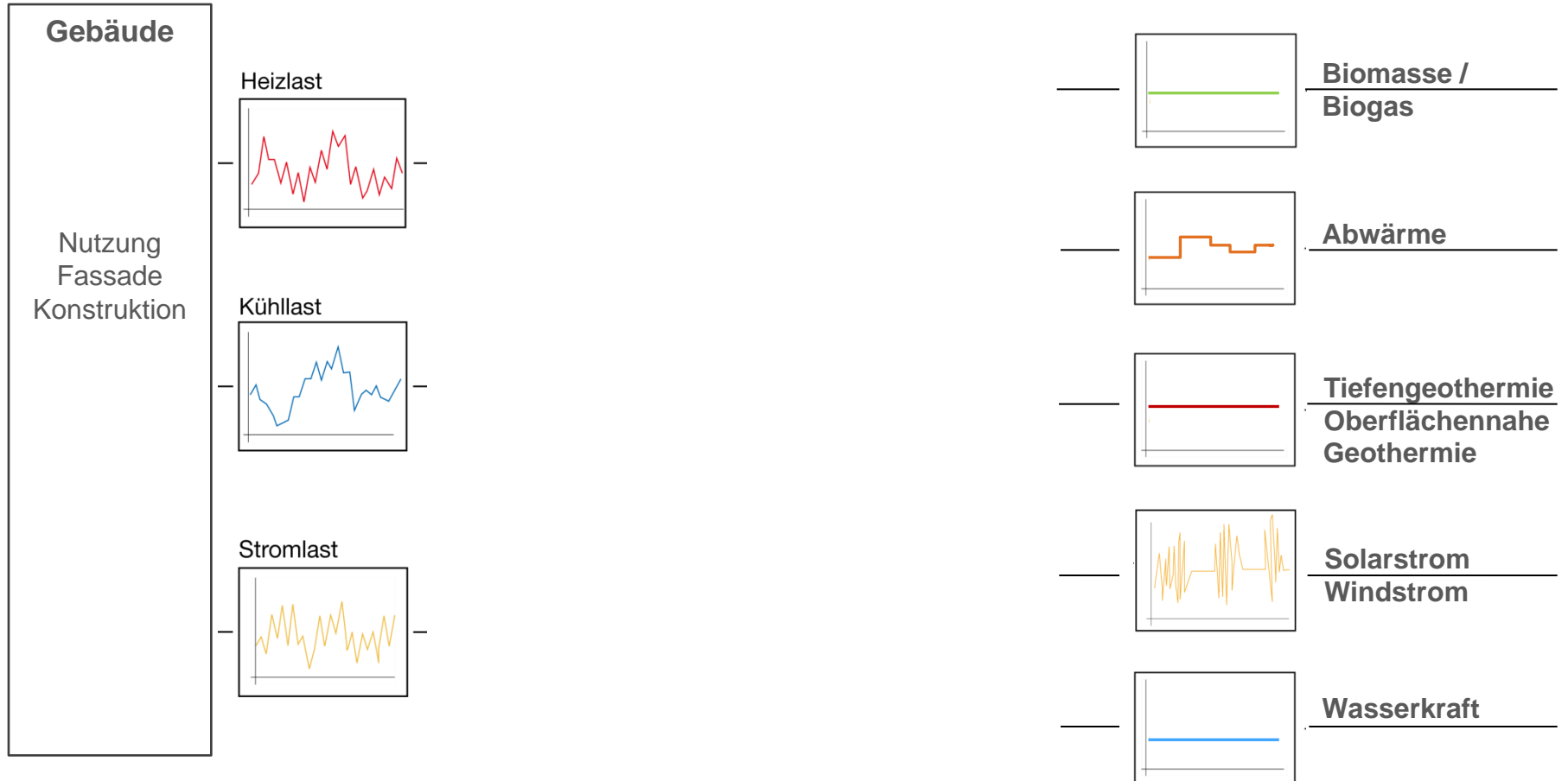
Öl / Gas

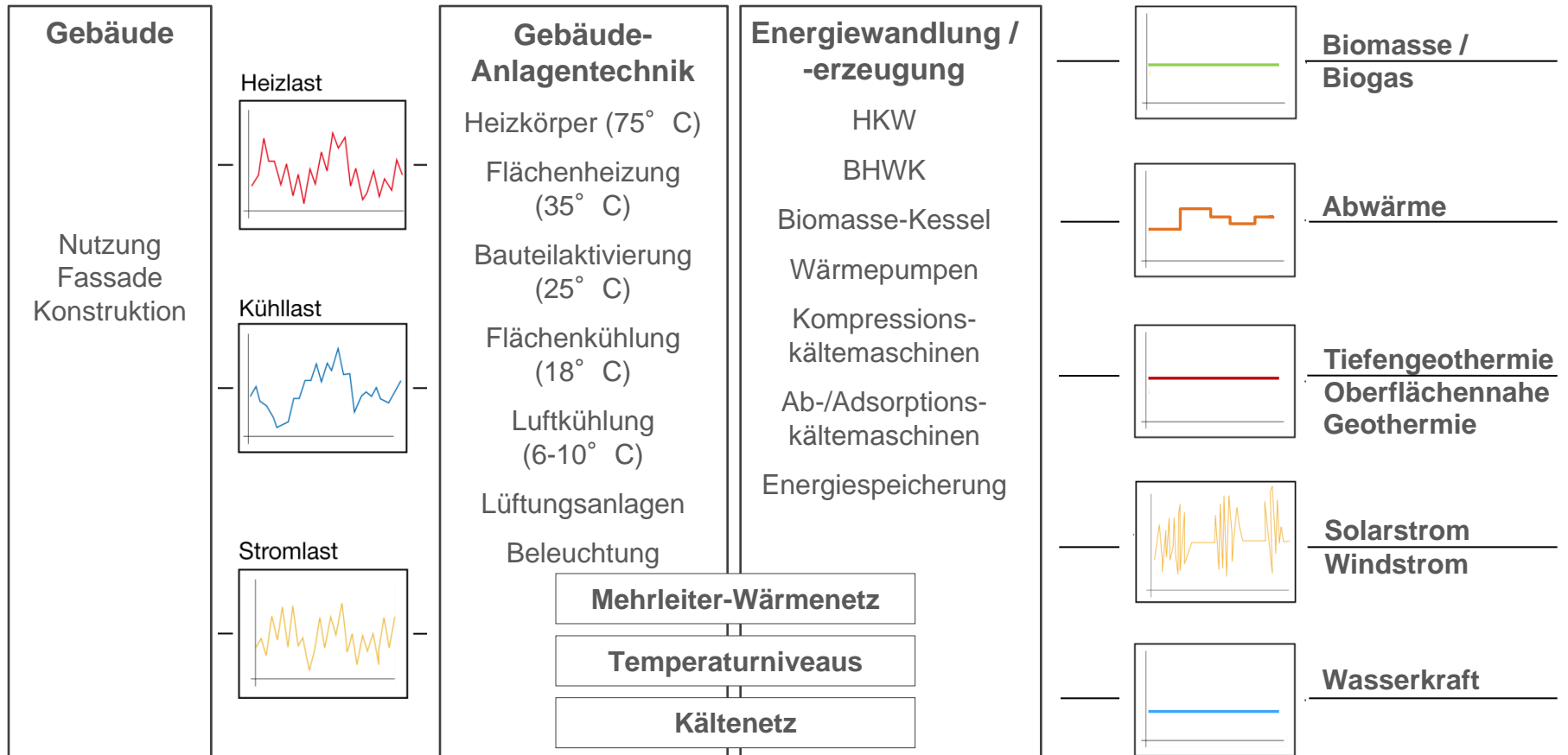
Strom

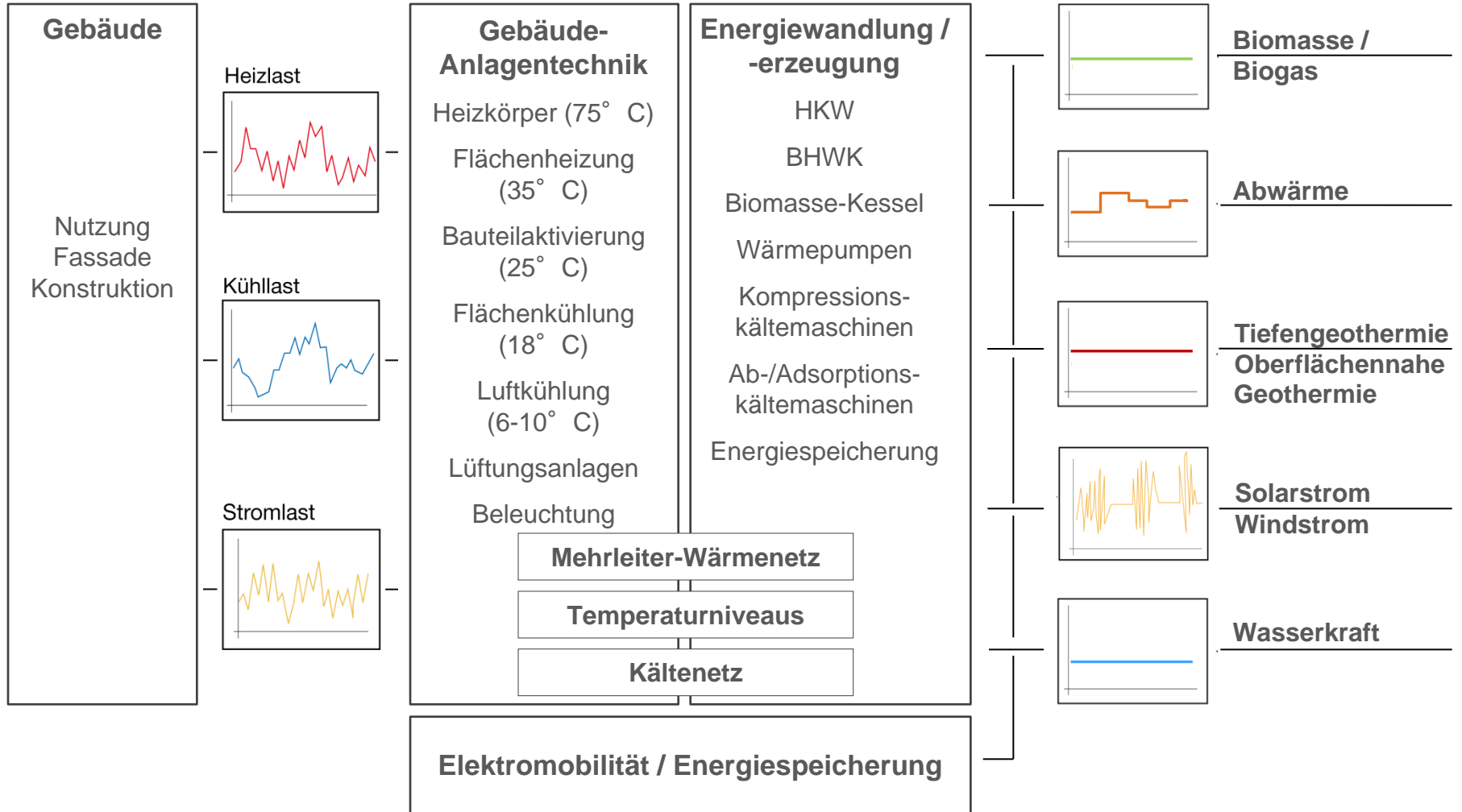




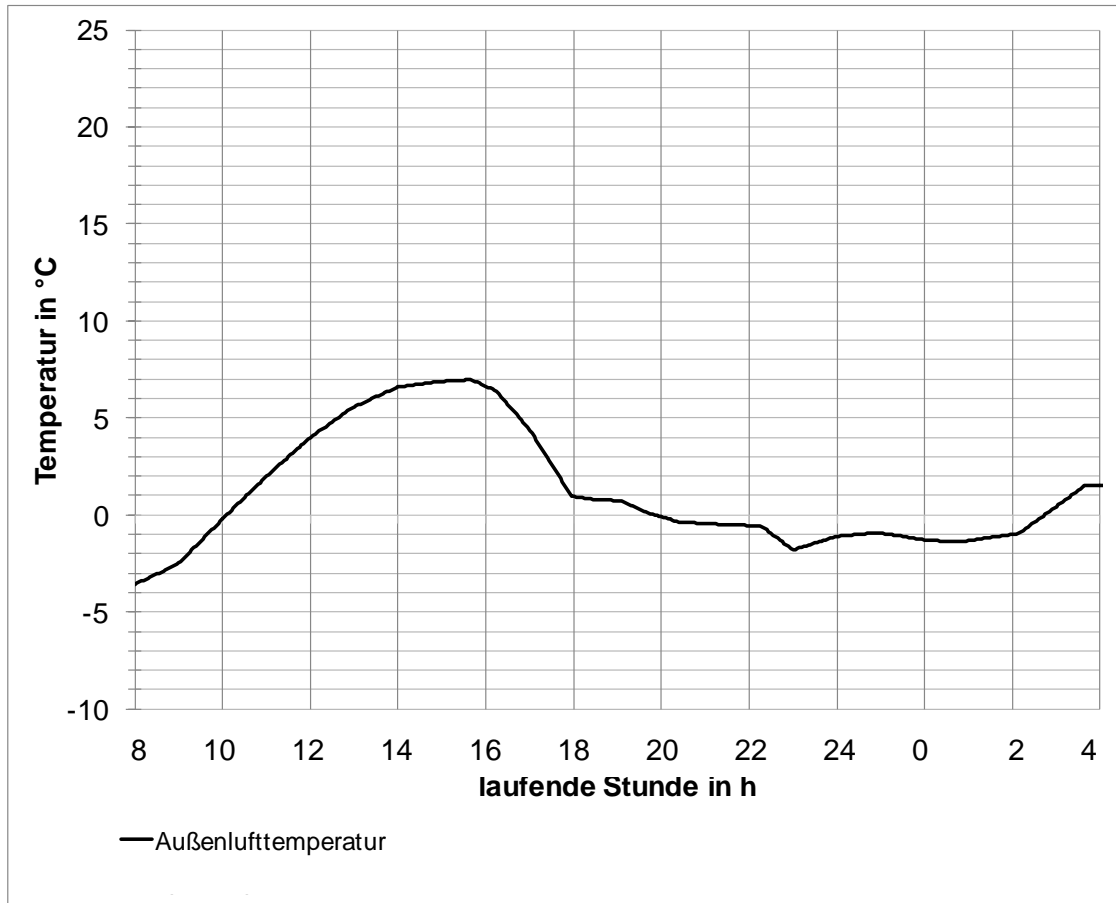




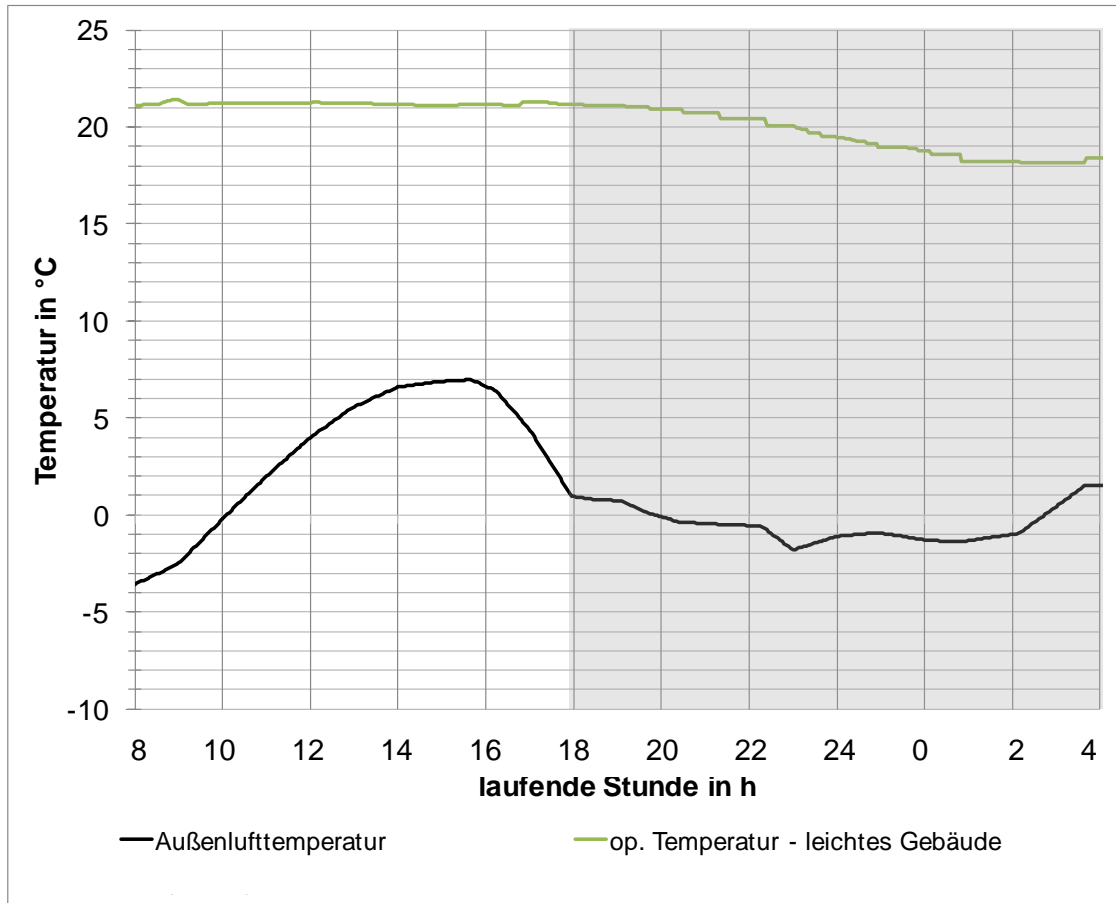




## Wärmespeicherpotential

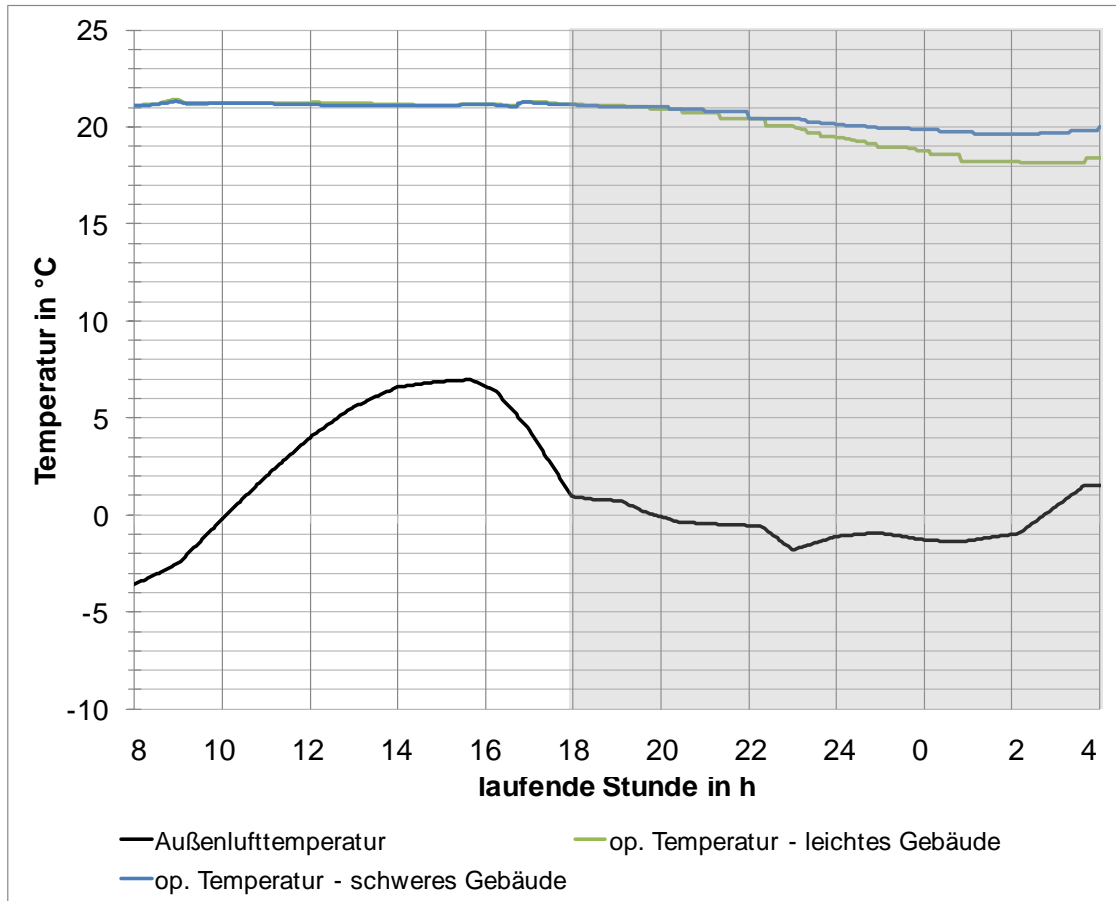


- 21. / 22. Januar



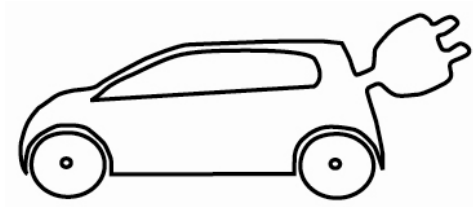
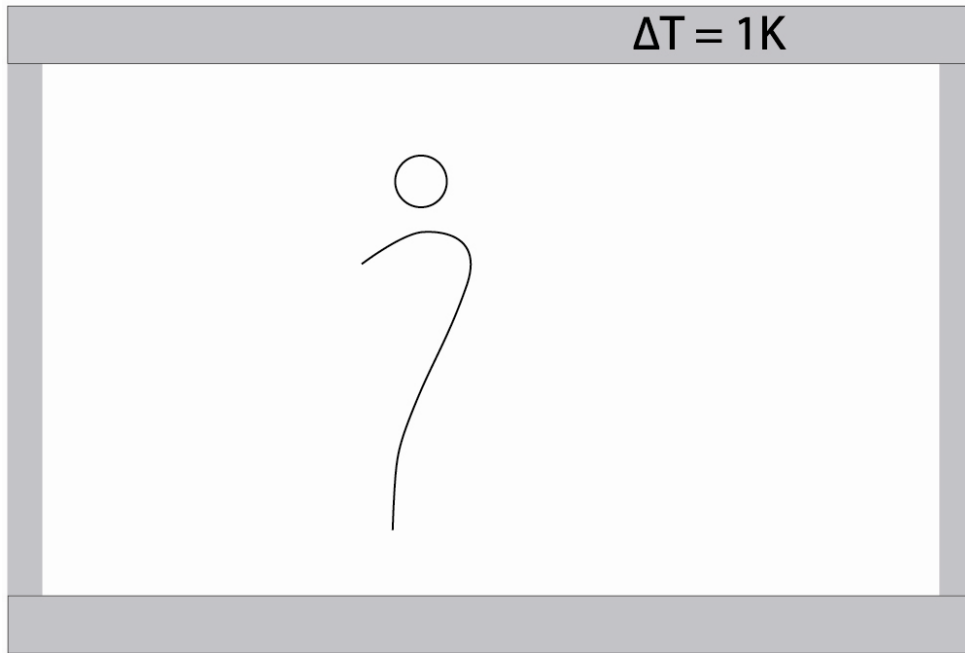
- 21. / 22. Januar
- vor Abschaltung  
 $\vartheta_{\text{op, leicht}} = 21,1^\circ \text{C}$
- nach ca. 6 h  
 $\vartheta_{\text{op, leicht}} = 19,3^\circ \text{C}$
- nach ca. 9 h  
 $\vartheta_{\text{op, leicht}} = 18,2^\circ \text{C}$





- 21. / 22. Januar
- vor Abschaltung  
 $\vartheta_{op, leicht} = 21,1^\circ C$   
 $\vartheta_{op, schwer} = 21,1^\circ C$
- nach ca. 6 h  
 $\vartheta_{op, leicht} = 19,3^\circ C$   
 $\vartheta_{op, schwer} = 20,0^\circ C$
- nach ca. 9 h  
 $\vartheta_{op, leicht} = 18,2^\circ C$   
 $\vartheta_{op, schwer} = 19,8^\circ C$

→ **Abschalten der Heizanlage auch über mehrere Stunden möglich**



Vision  
(100% Wärmepumpenanteil)

**438.750 MWh<sub>thermisch</sub>**



**112.500 MWh<sub>elektrisch</sub>**



**3.750.000 Elektroautos**

Wärmespeicherpotential – Heizfall

