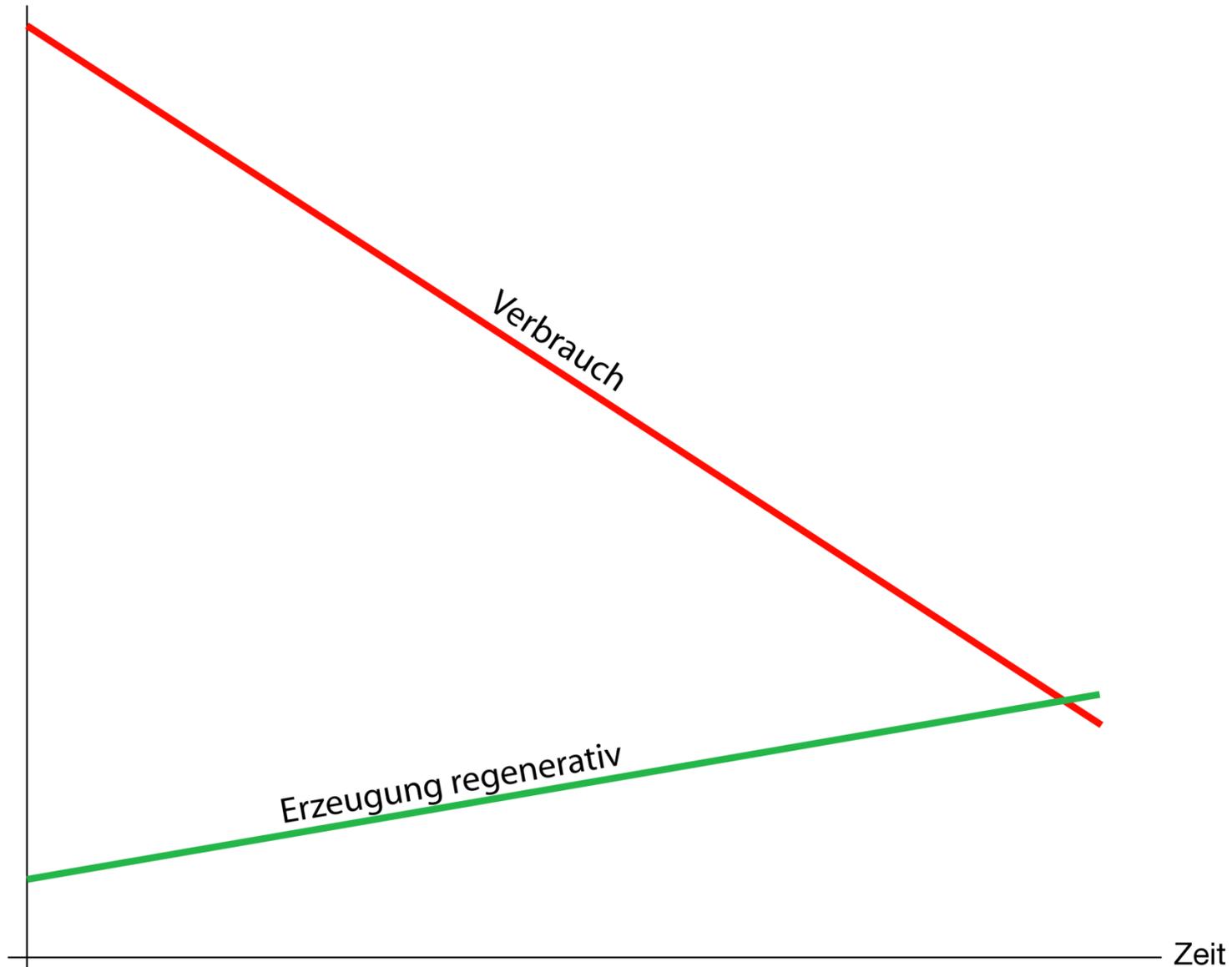




Energie



Energie







Heliotrop - Rolf Disch



Plusenergiegebäude - Solar Decathlon
TU Darmstadt 2008 / 2009



Plusenergiegebäude Berlin
Werner Sobek 2011



Aktiv - Stadthaus Frankfurt





Systemgrenzen festlegen

Energie

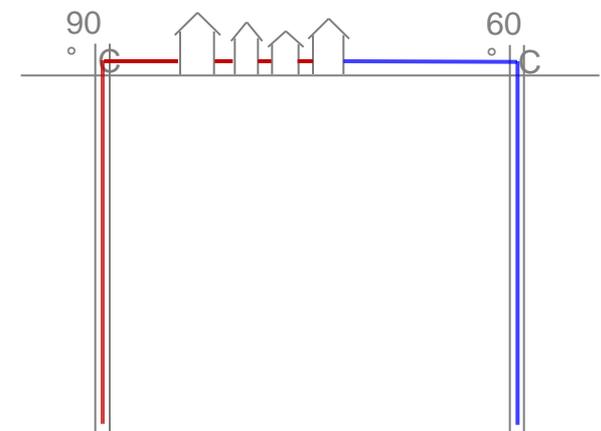
Energie

Energie  Exergie (Wertigkeit)

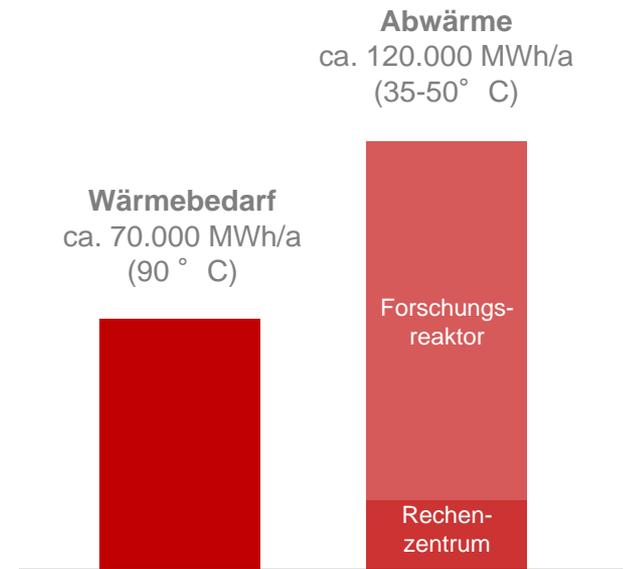
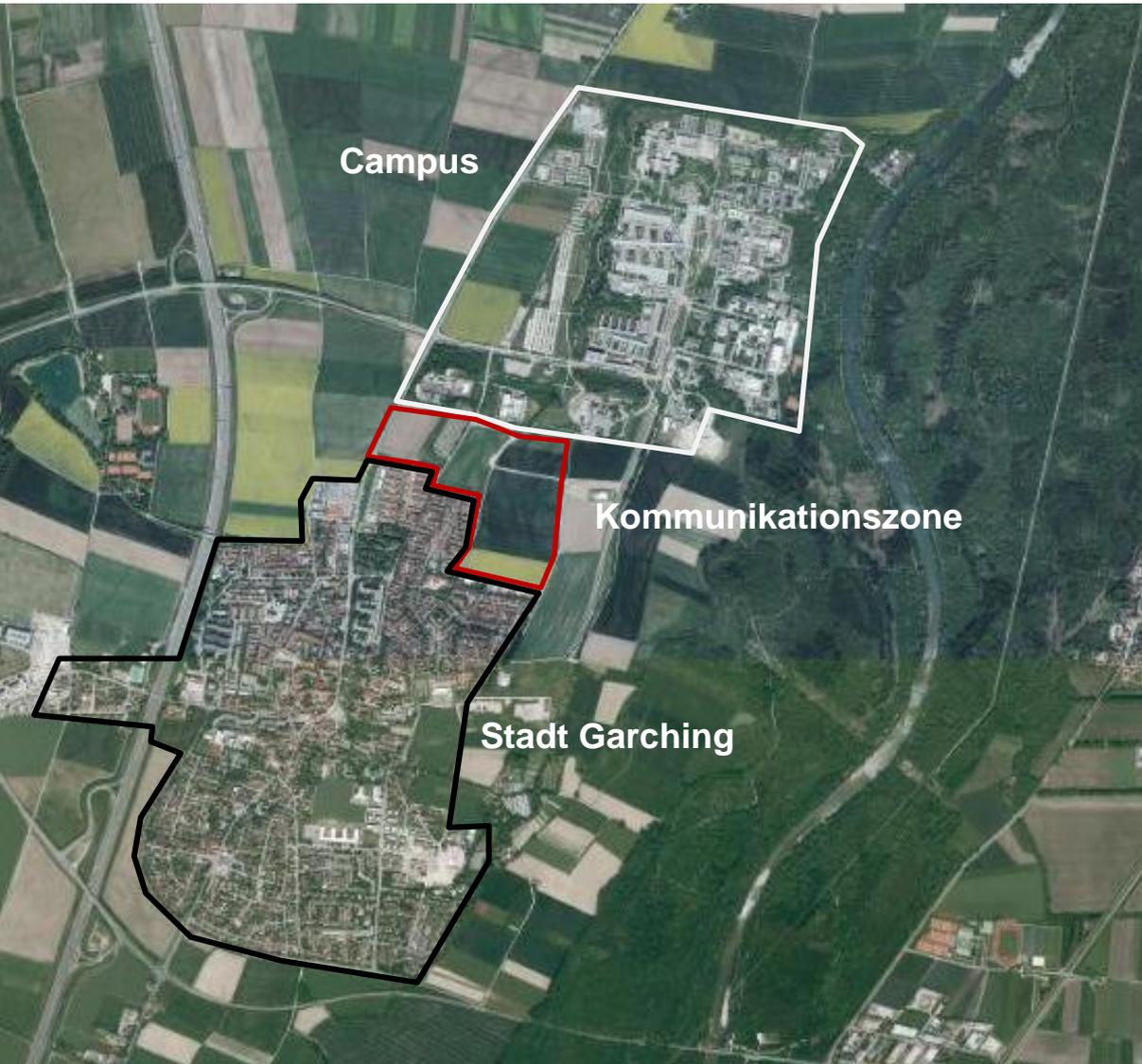
Energie

Energie  Exergie (Wertigkeit)

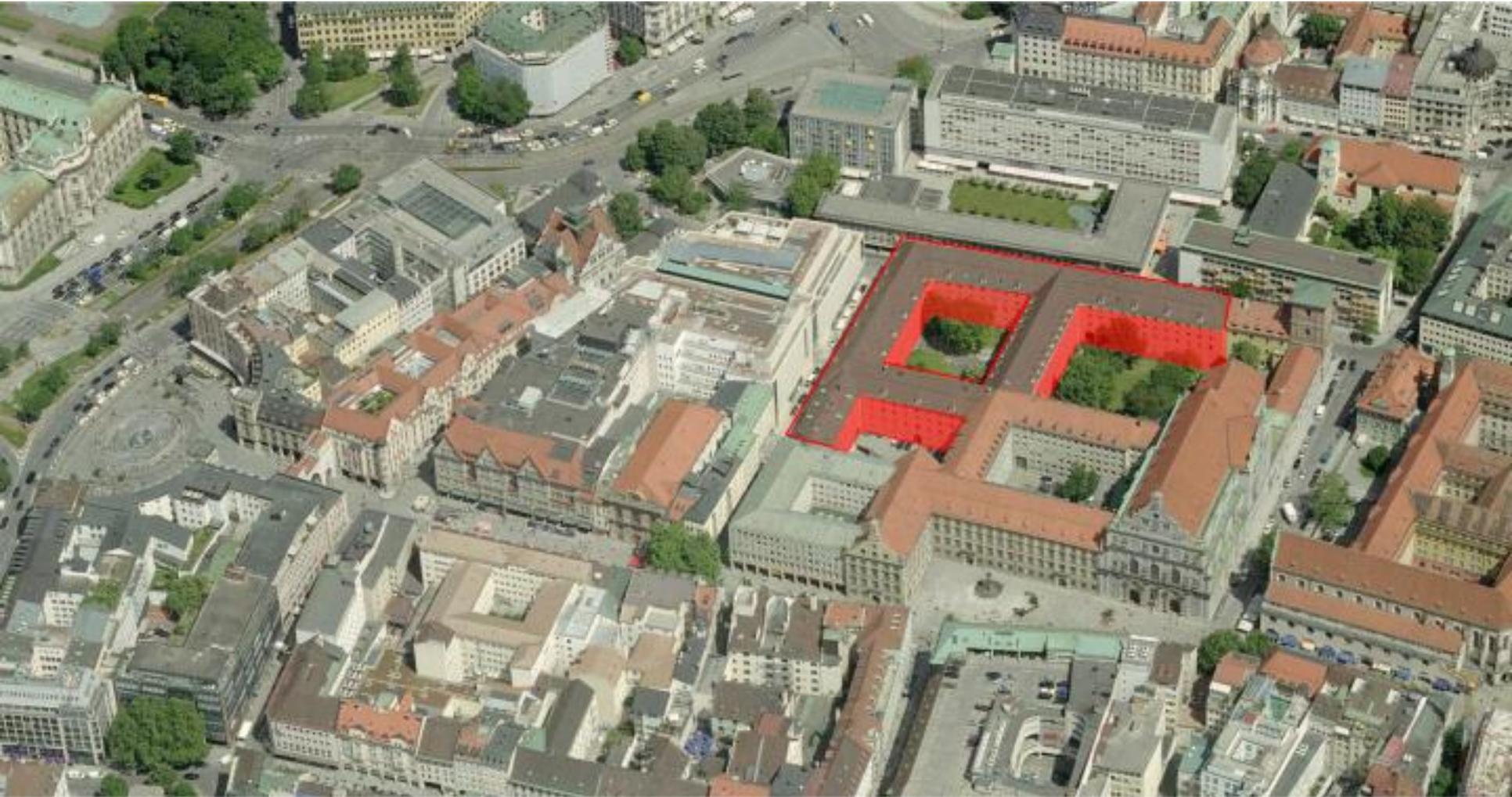
Energie  Verfügbarkeit von Energie



Wertigkeit der Energie



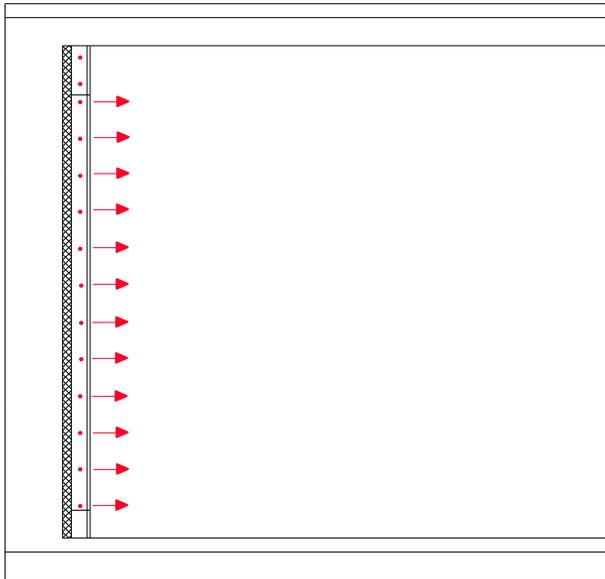
Ordinariat München



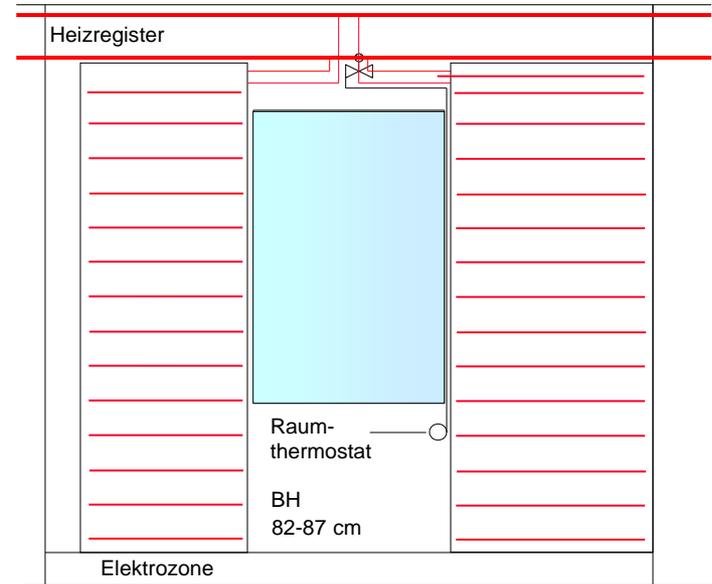




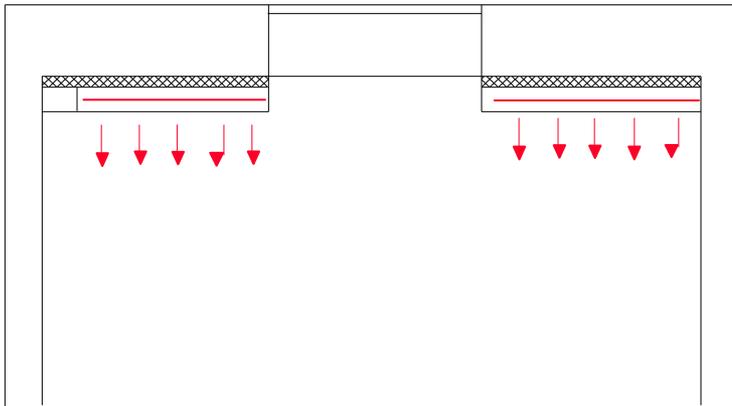




Schnitt - Wandheizsystem



Ansicht - Innenwand mit Wandheizsystem



Grundriss - Wandheizsystem

Vorlauftemperatur

90°C

40°C

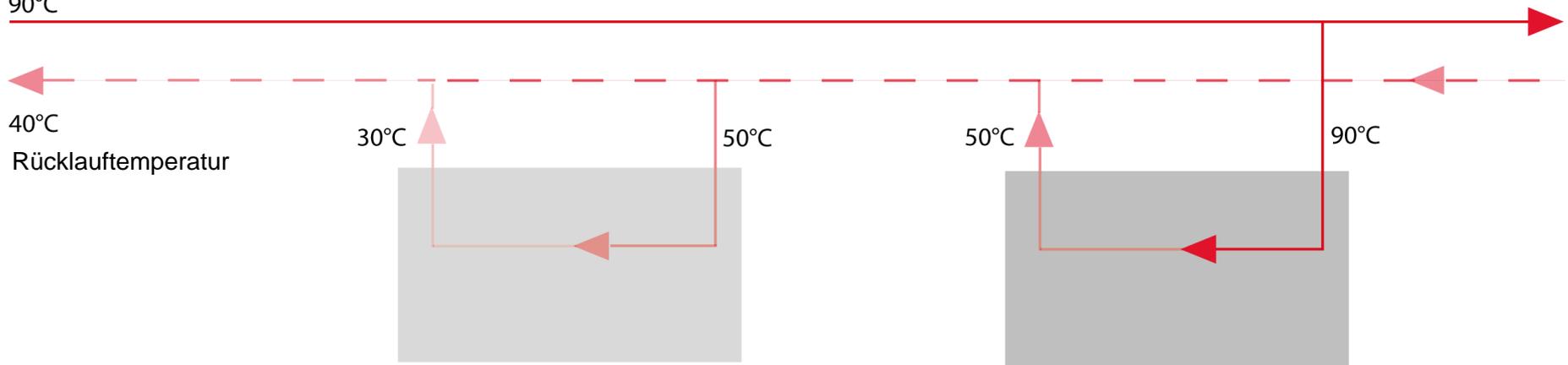
Rücklauftemperatur

30°C

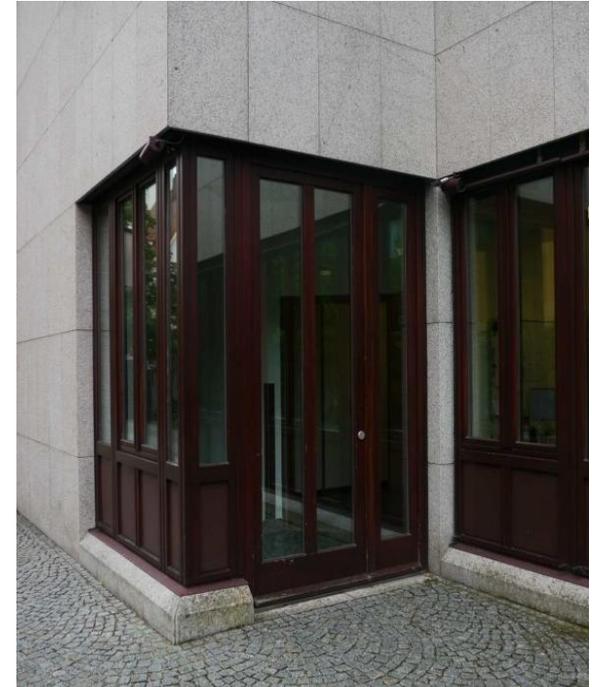
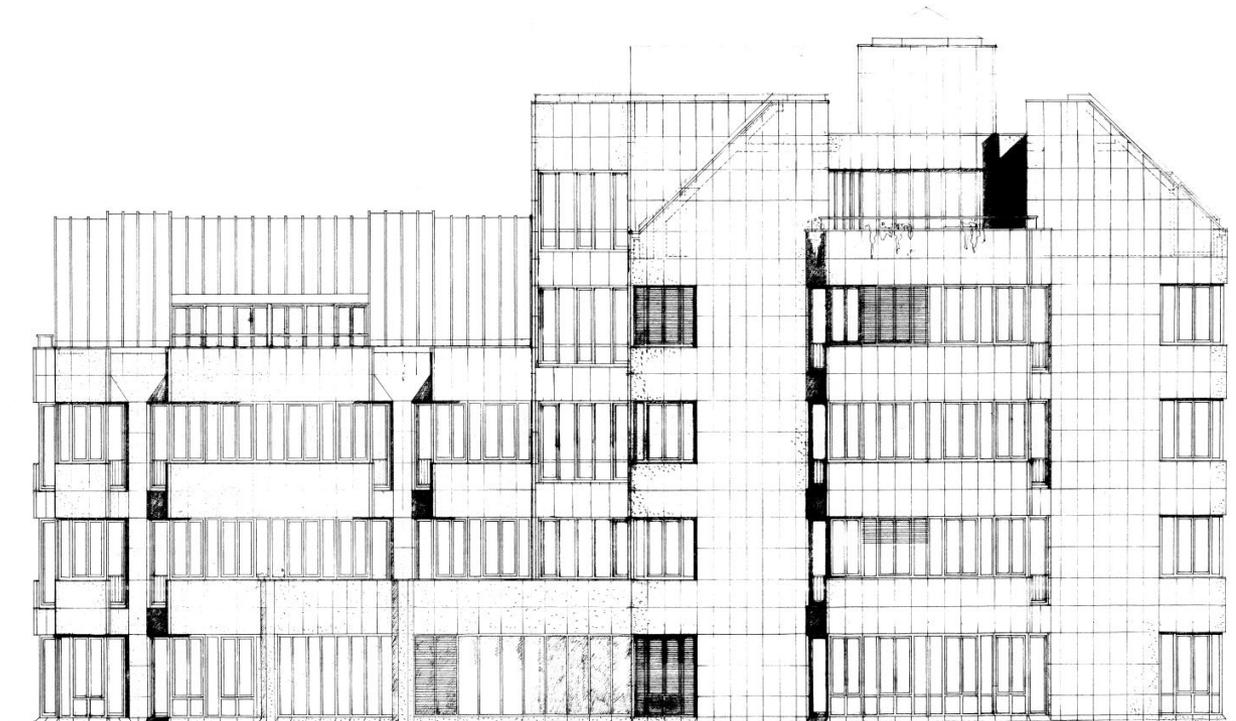
50°C

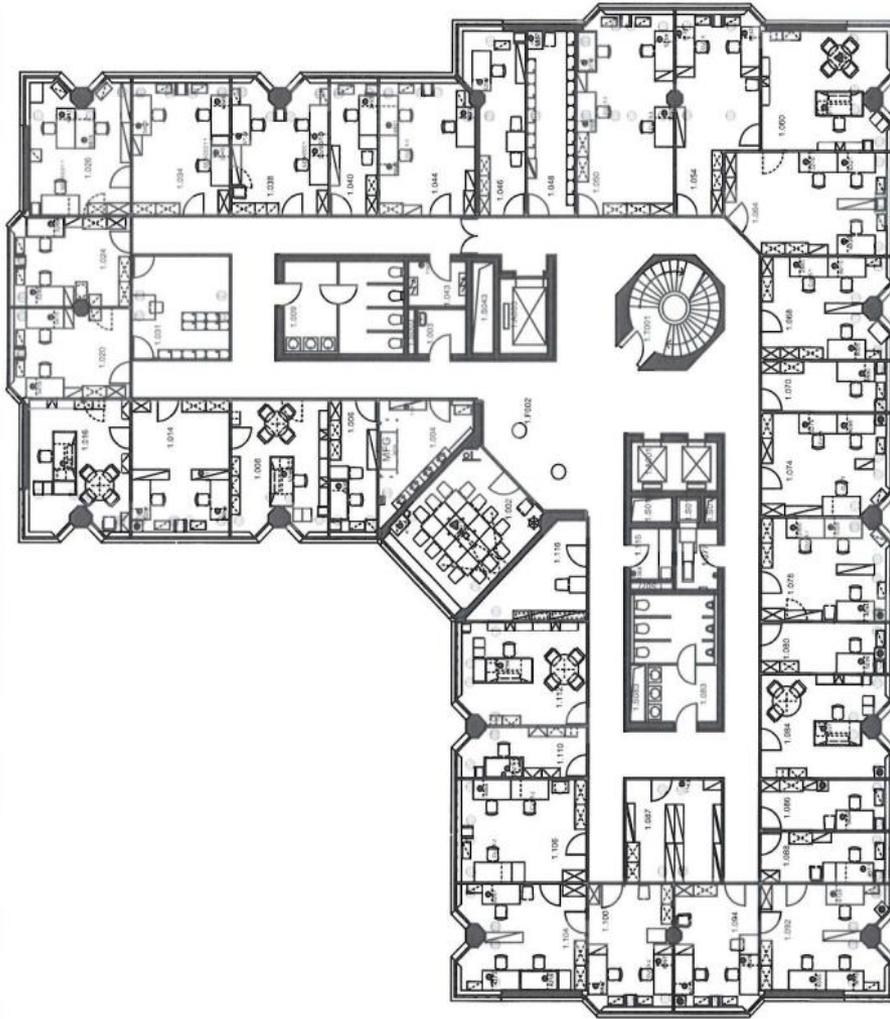
50°C

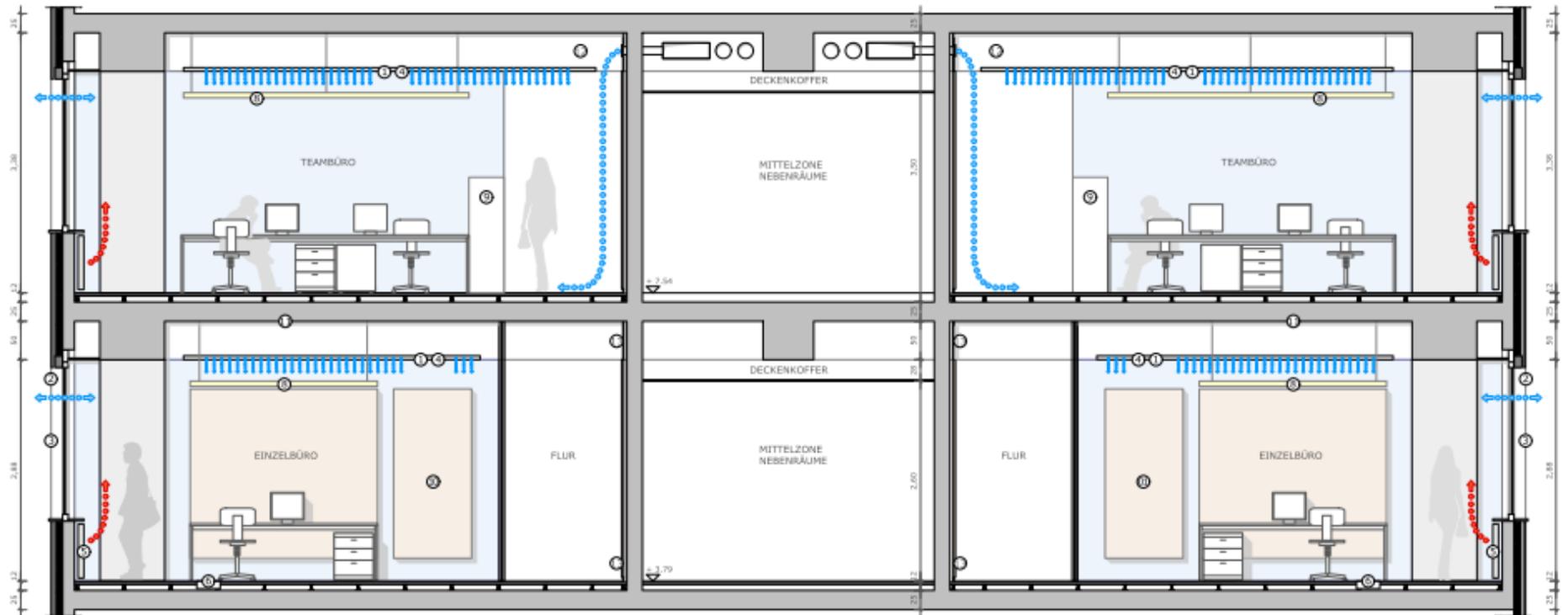
90°C



Sanierung Verwaltungsgebäude München



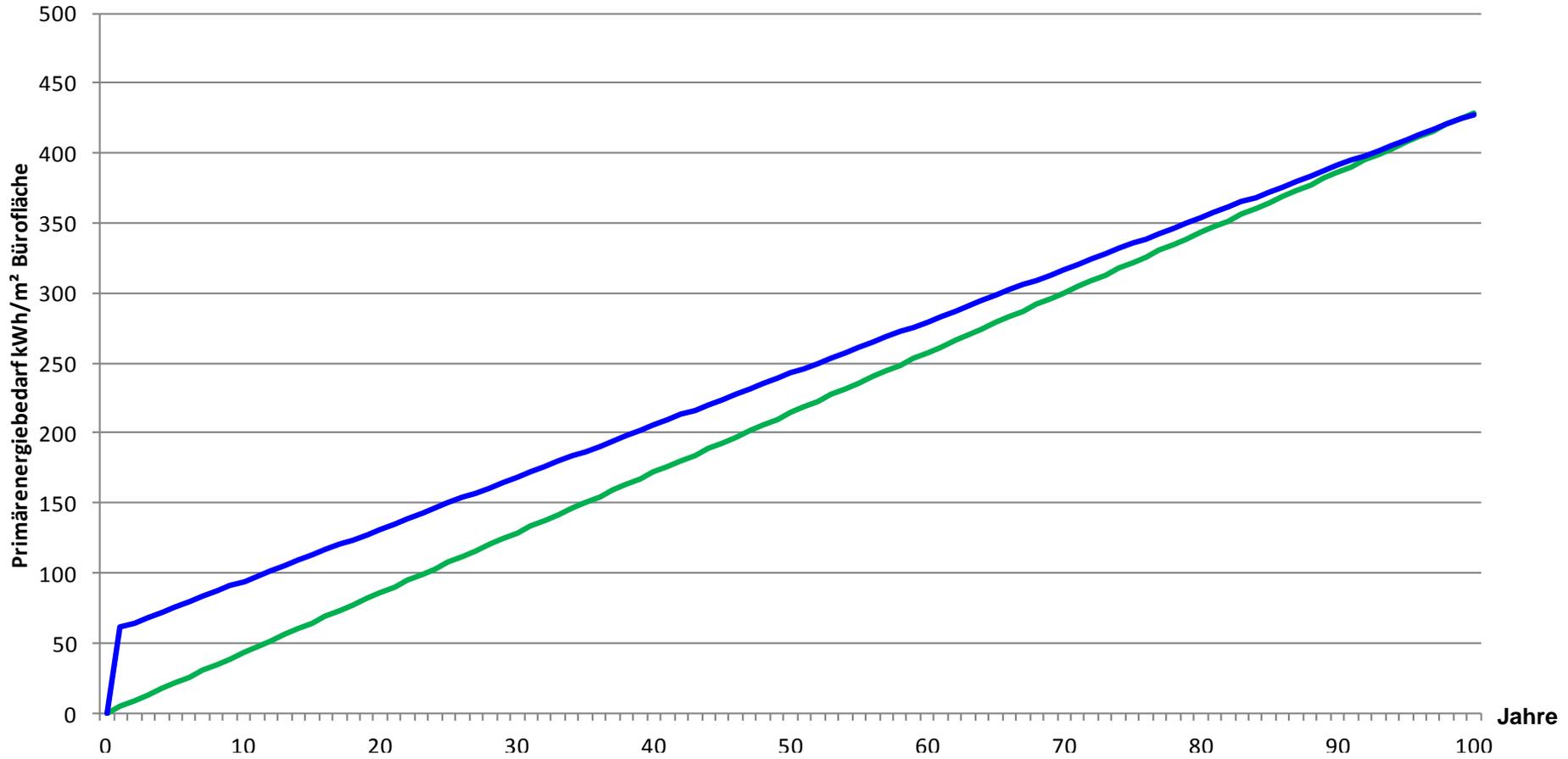




Schnitt neue Haustechnik

Kumulierter Primärenergiebedarf

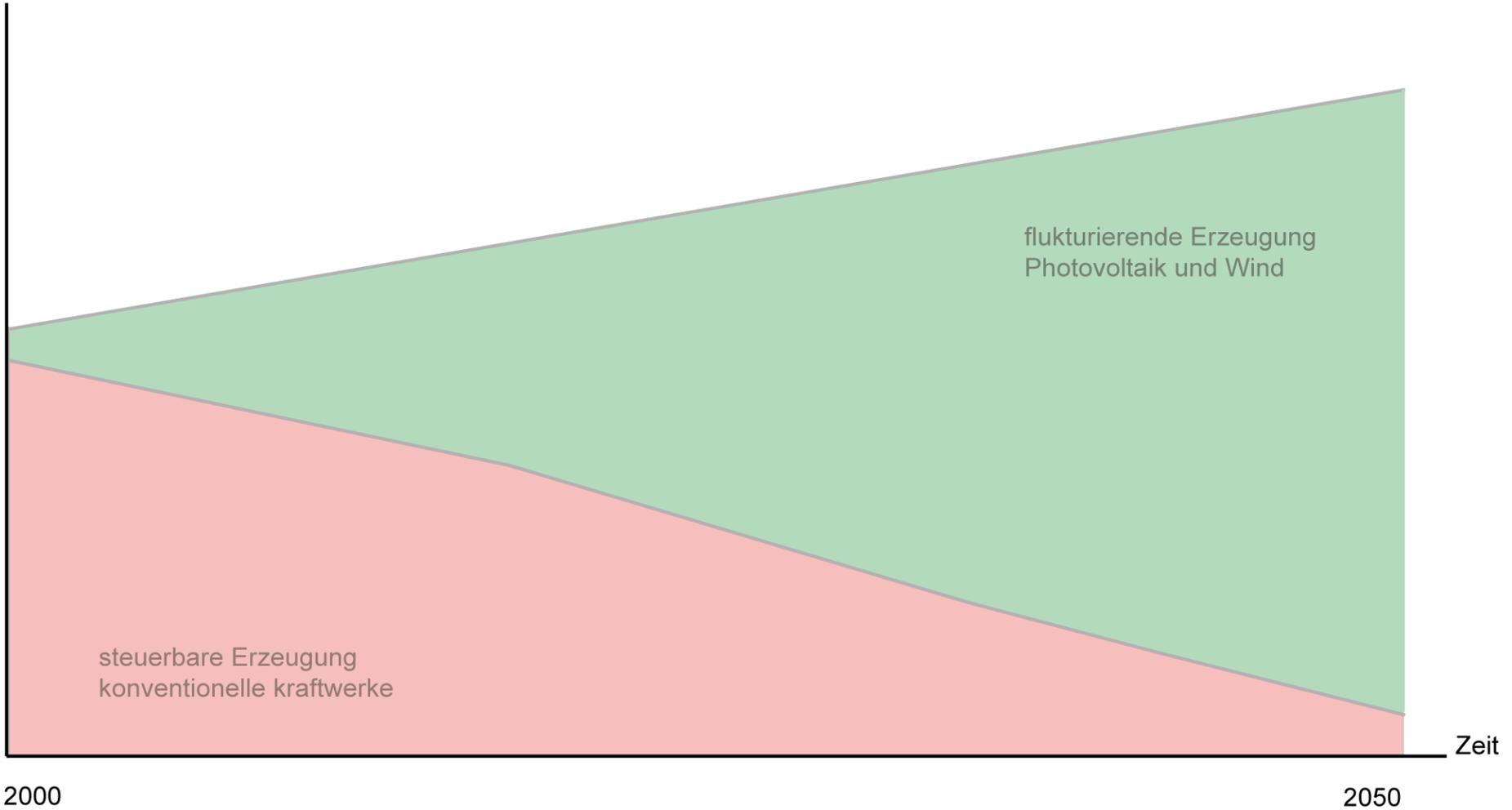
— ohne neue Aussenwanddämmung — mit neuer Aussenwanddämmung



Vergleich der Sanierungsvariante

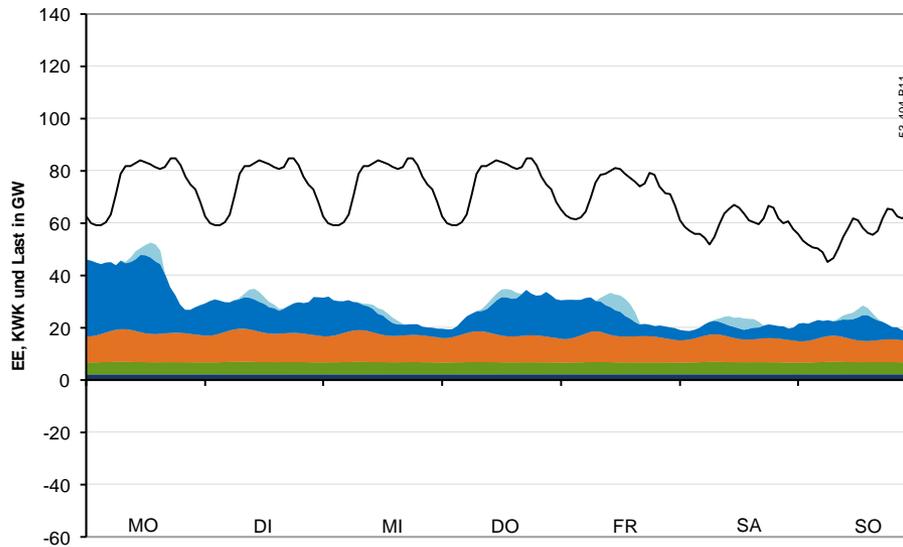
Zeitliche Verfügbarkeit von Energie - Lastverläufe

Kraftwerksleistung

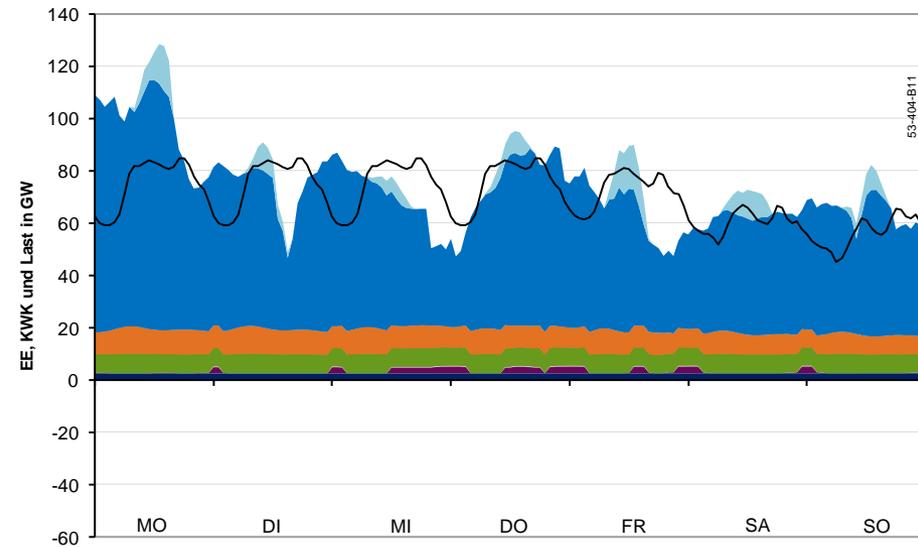


Entwicklung der Stromerzeugung

Stromverbrauch / Stromerzeugung heute - Winter

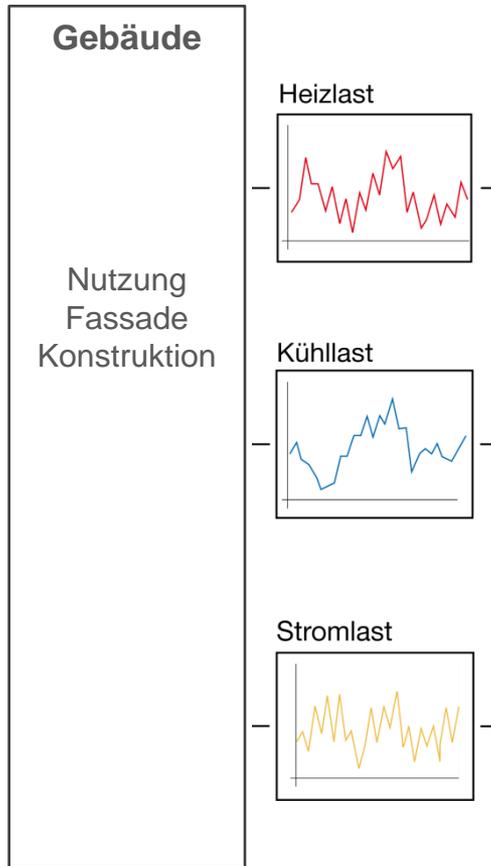


Stromverbrauch / Stromerzeugung zukünftig - Winter



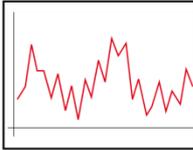
[Kuhn, 2011, IfE]

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

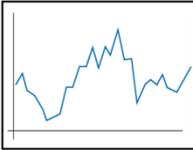




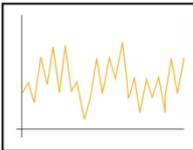
Heizlast



Kühllast



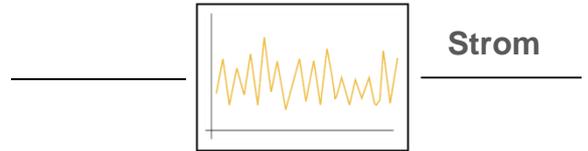
Stromlast

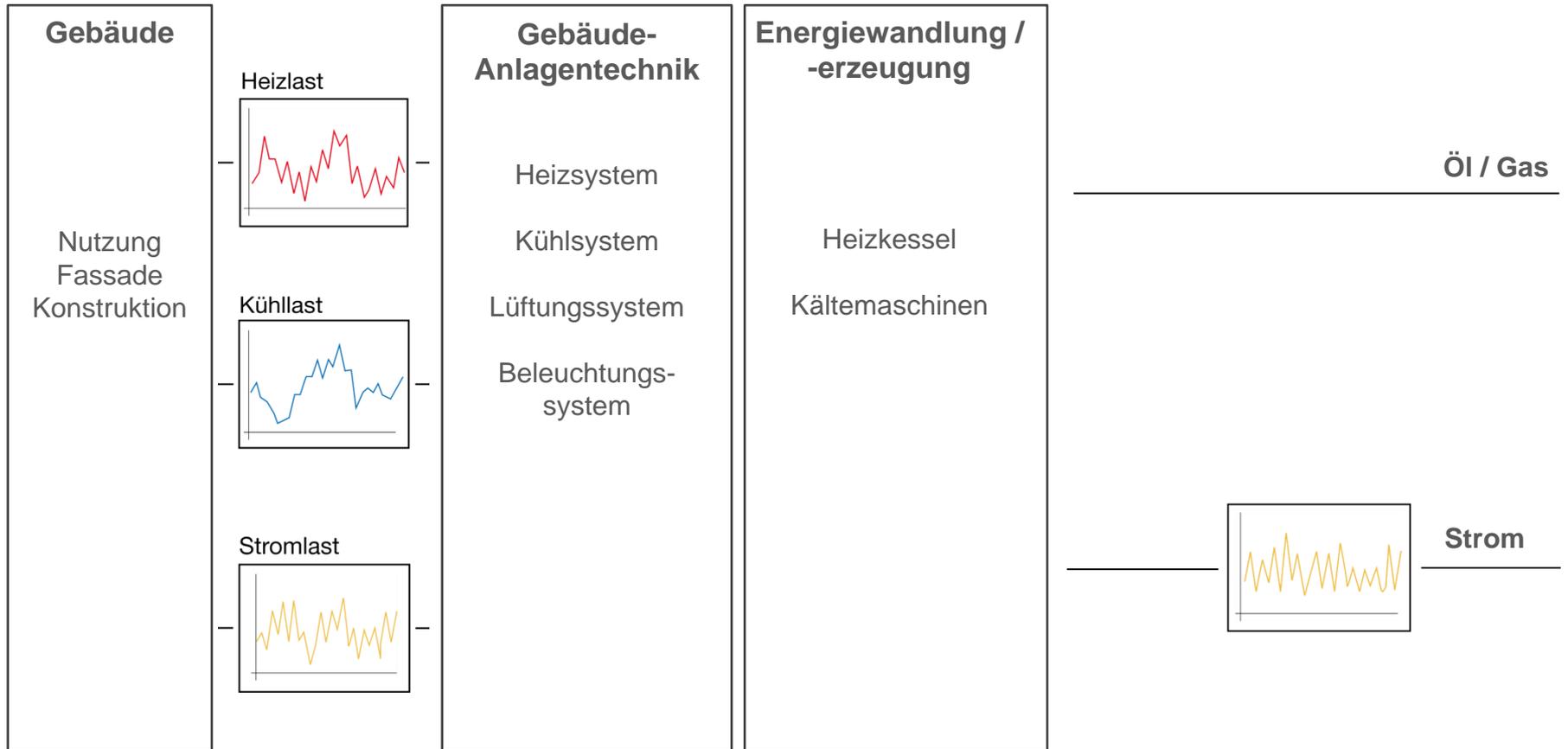


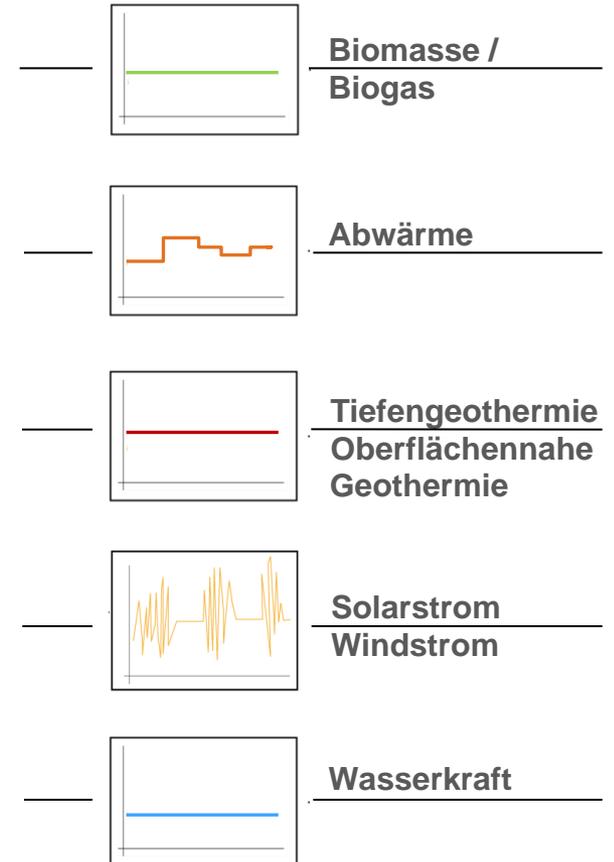
Öl / Gas

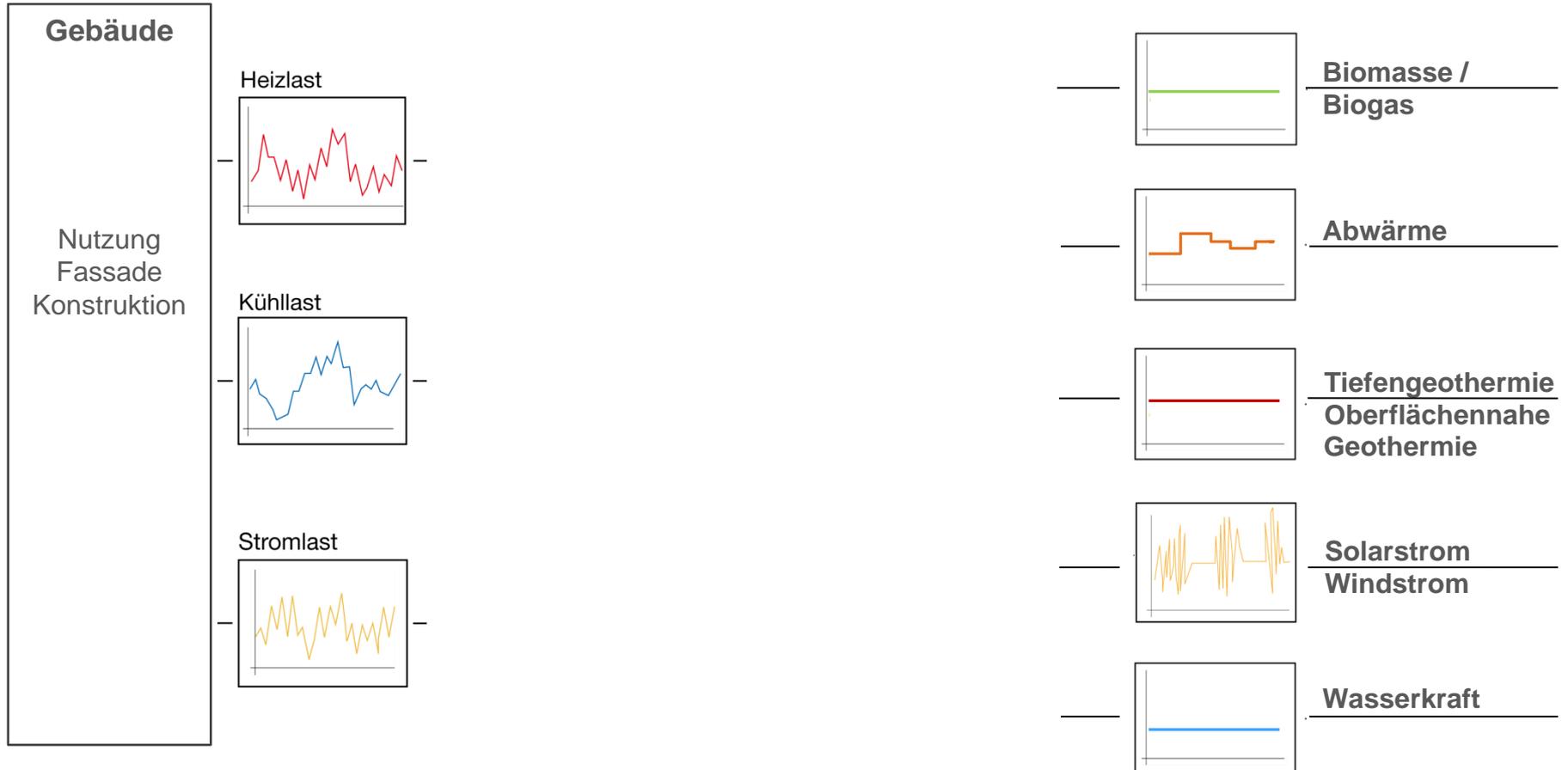


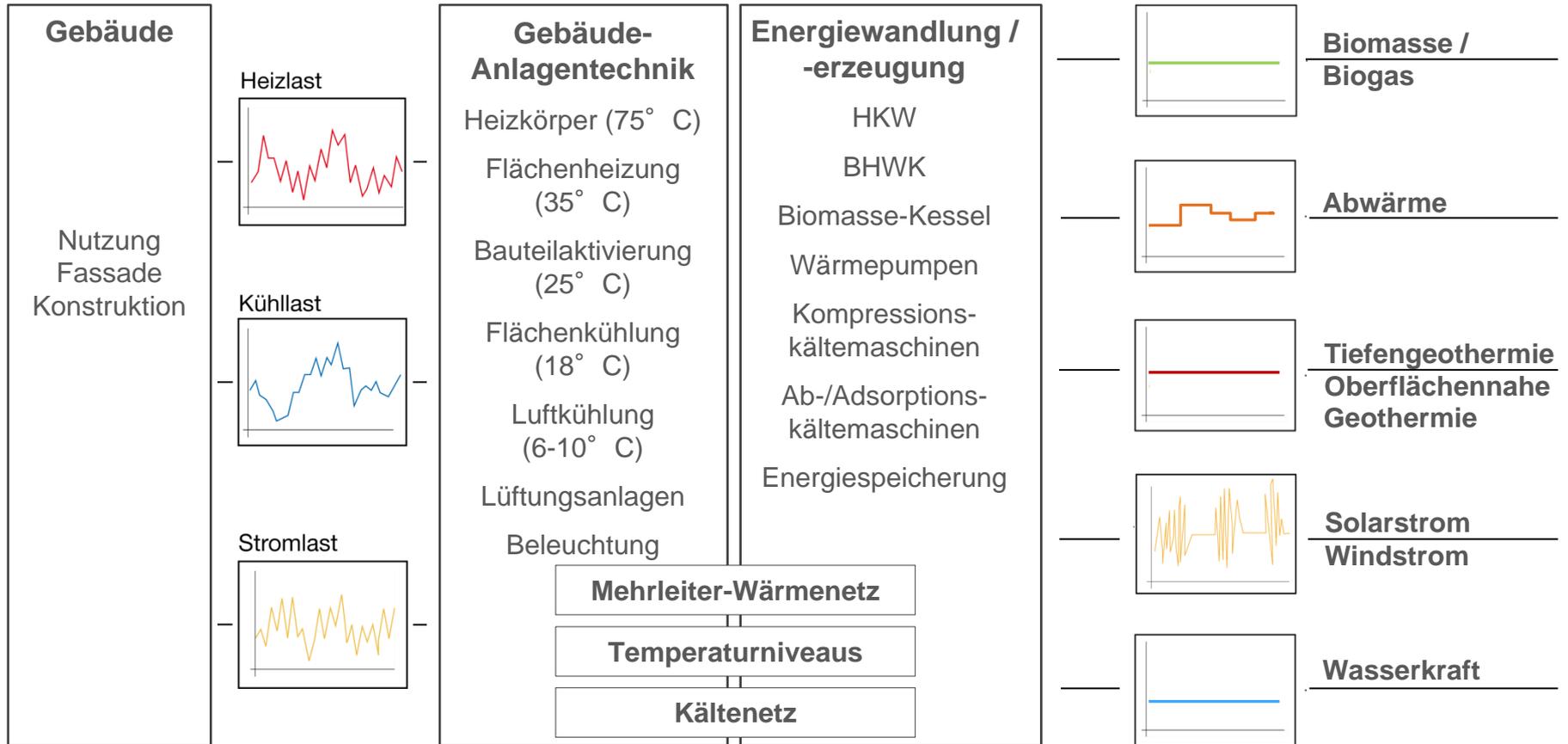
Strom

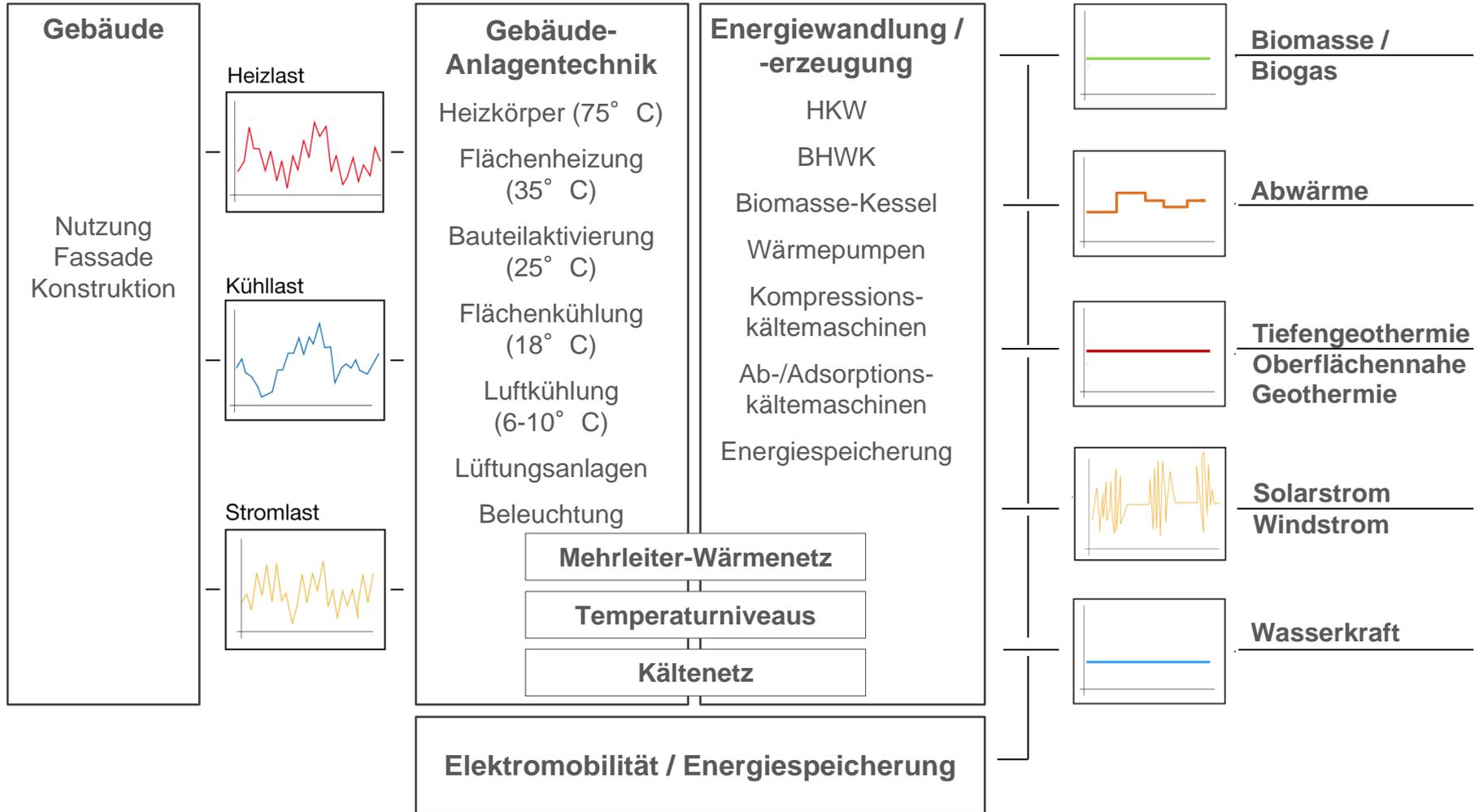




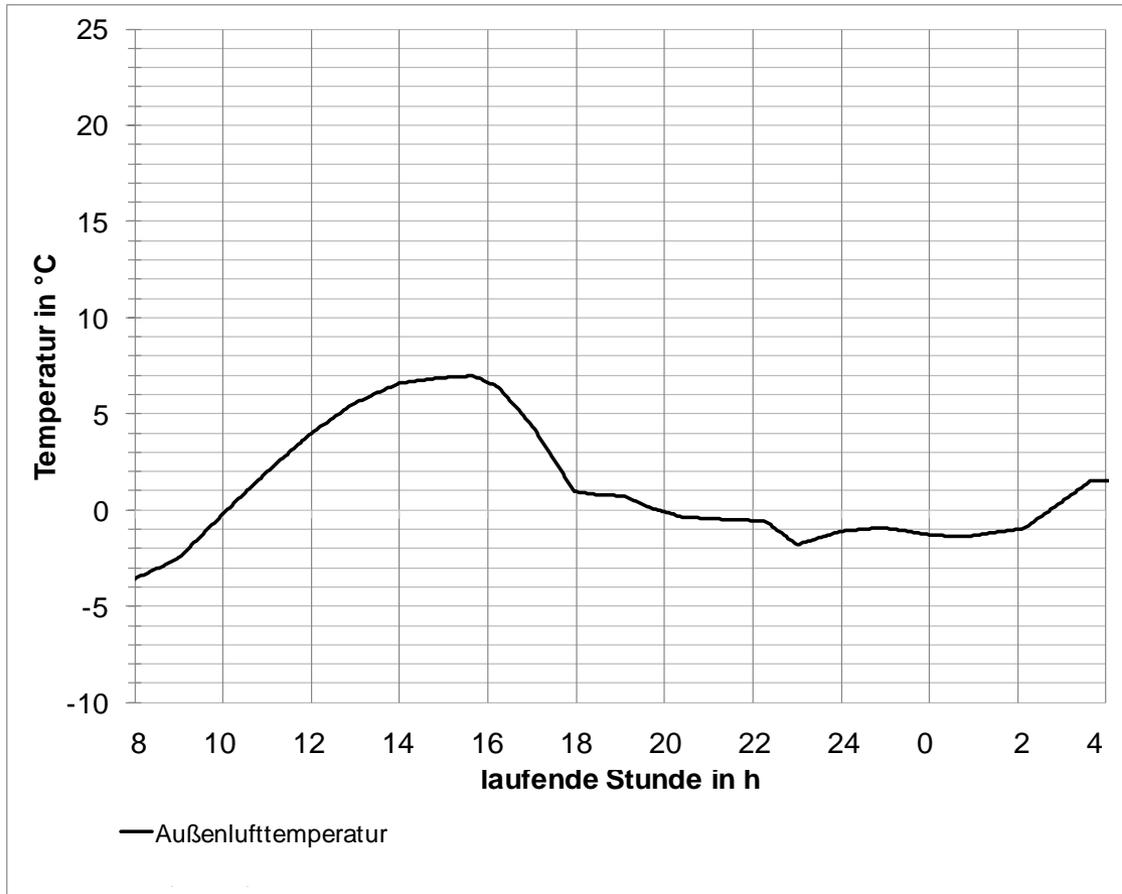




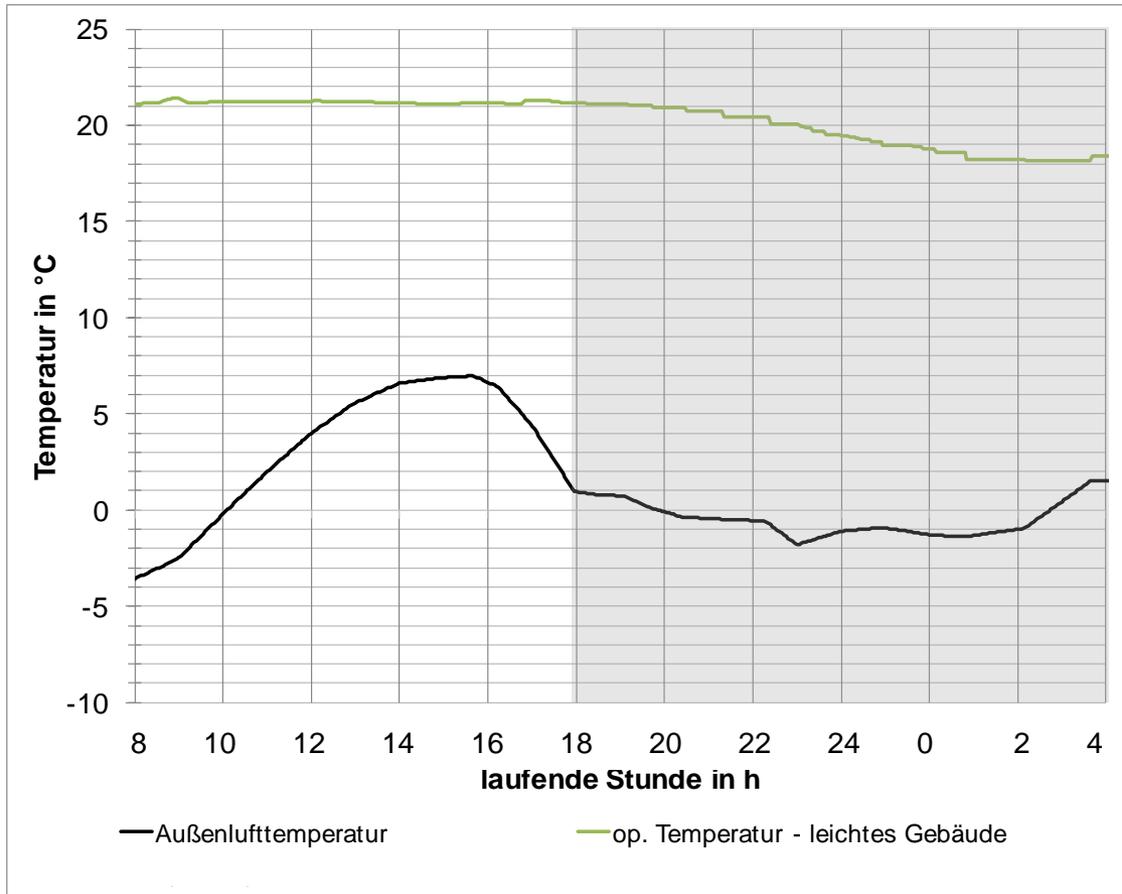




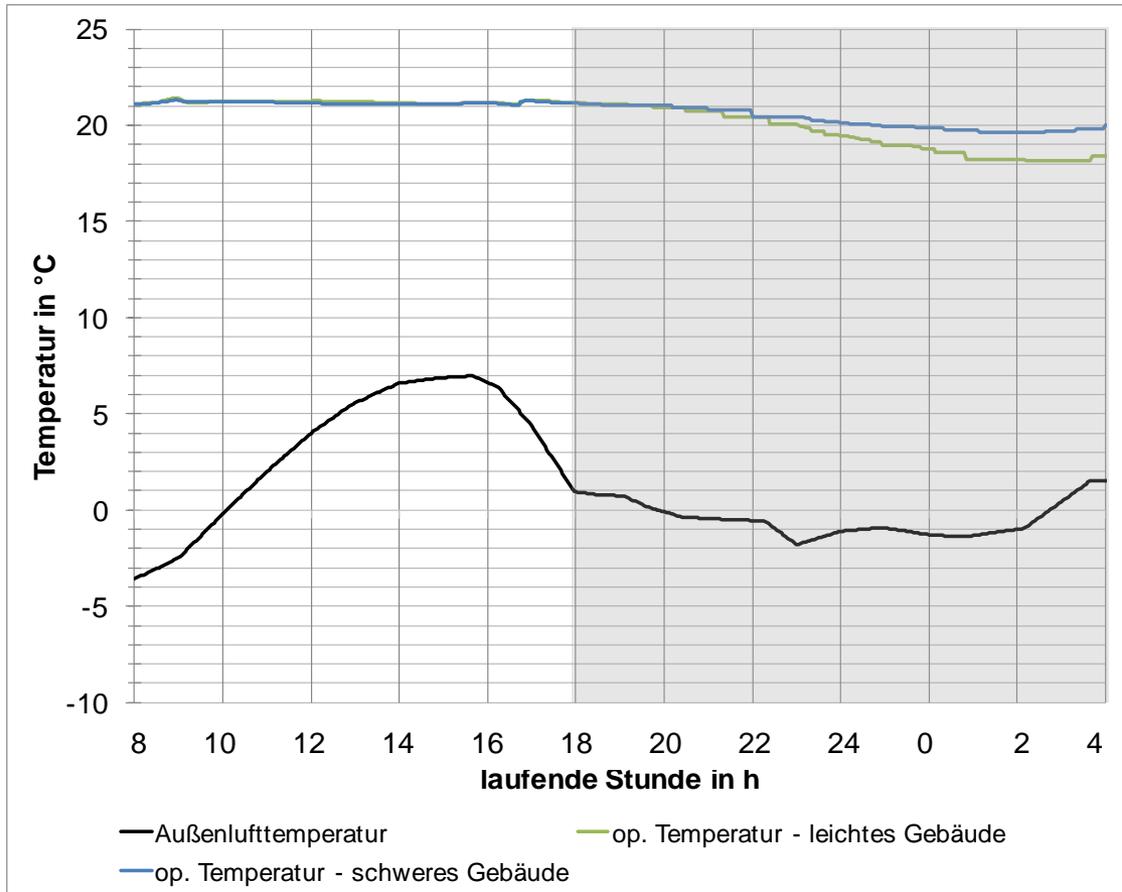
Wärmespeicherpotential



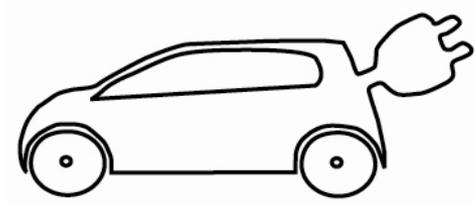
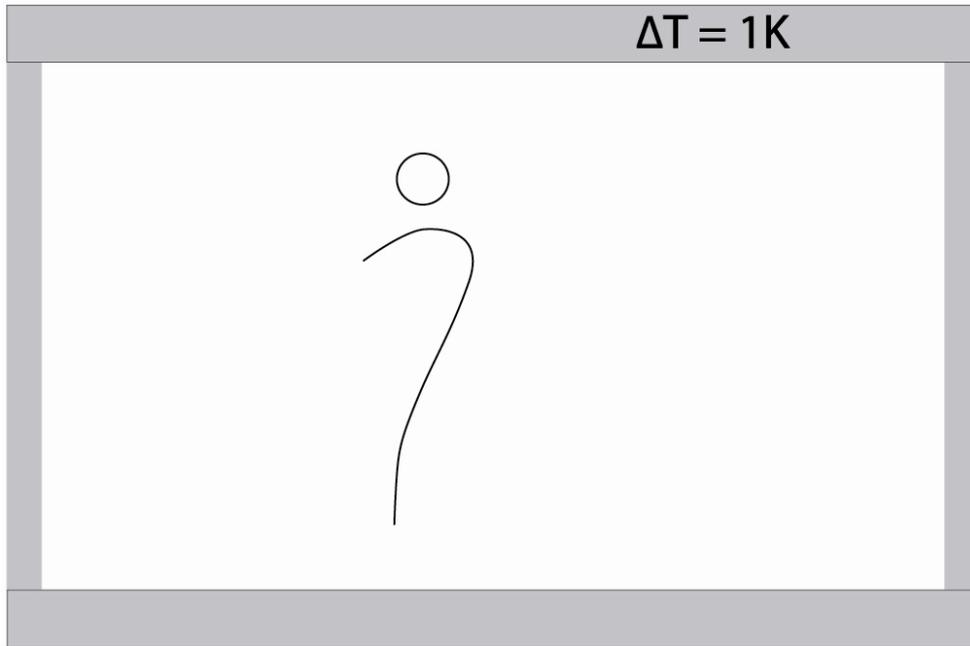
- 21. / 22. Januar



- 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_{thermisch}



112.500 MWh_{elektrisch}



3.750.000 Elektroautos

Wärmespeicherpotential – Heizfall

