



Energy demand of office buildings

Calculated and measured energy performance

**IEA Annex 61 – Technical Day
21th Sept. 2015, Hotel Harkamp, St. Nikolai i.S.
DI Gerhard Bayer, ÖGUT**

Method of the study

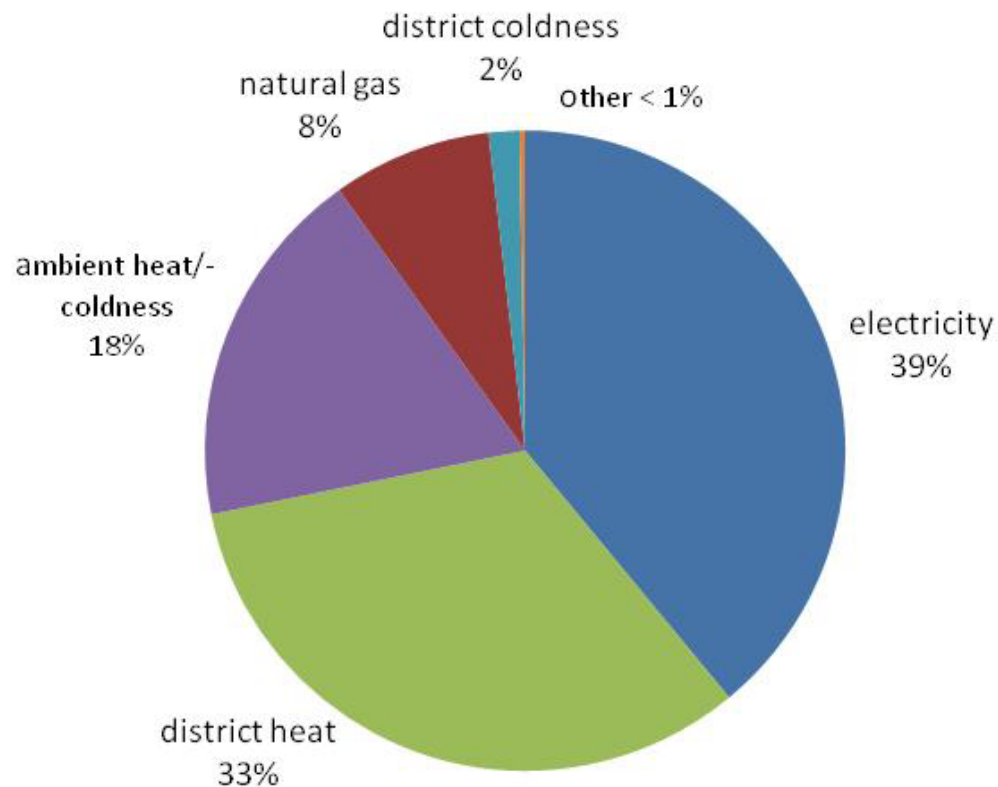


- **Analyses of 20 office buildings in Vienna region (285.000 m² GFA)**
- **wide range at year of construction, size and compactness**
- **Energy demand devided by:**
 - ◆ Space heating, hot water, cooling, lighting, ventilation and operating current
- **Data appraisal anonymous**

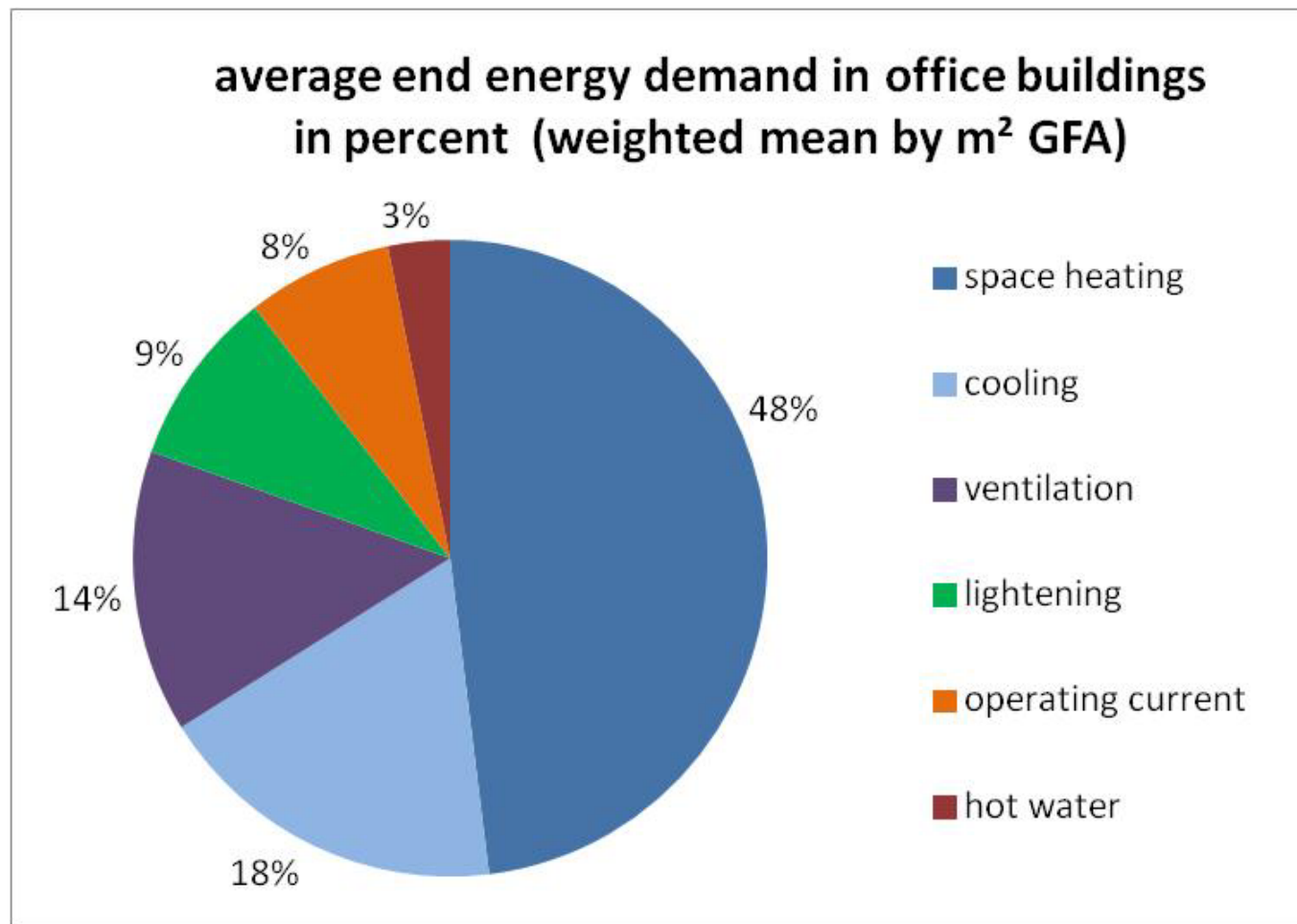
Energy input in office buildings by energy sources



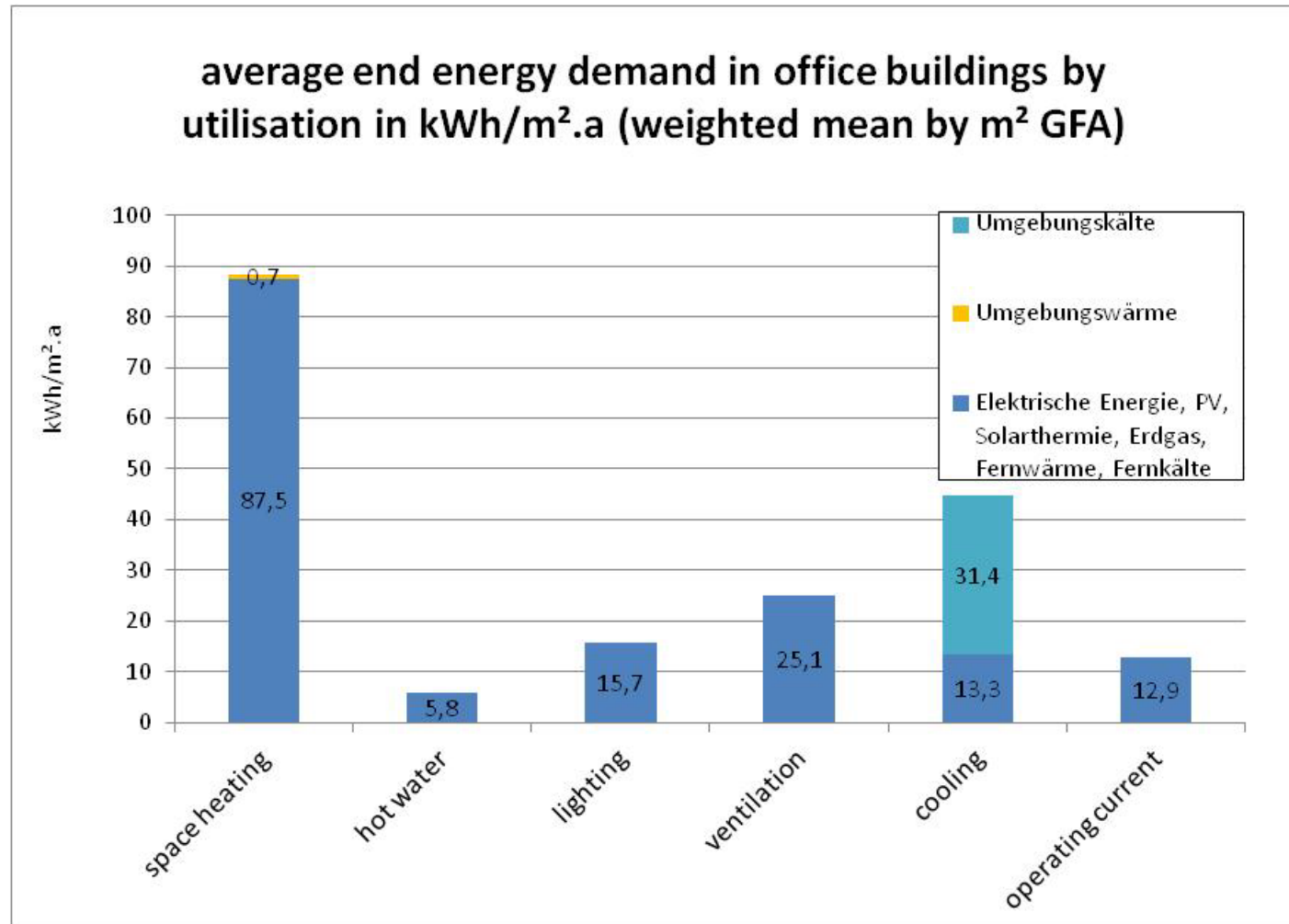
average energy input of all 20 buildings in percent
(weighted average by m² GFA)



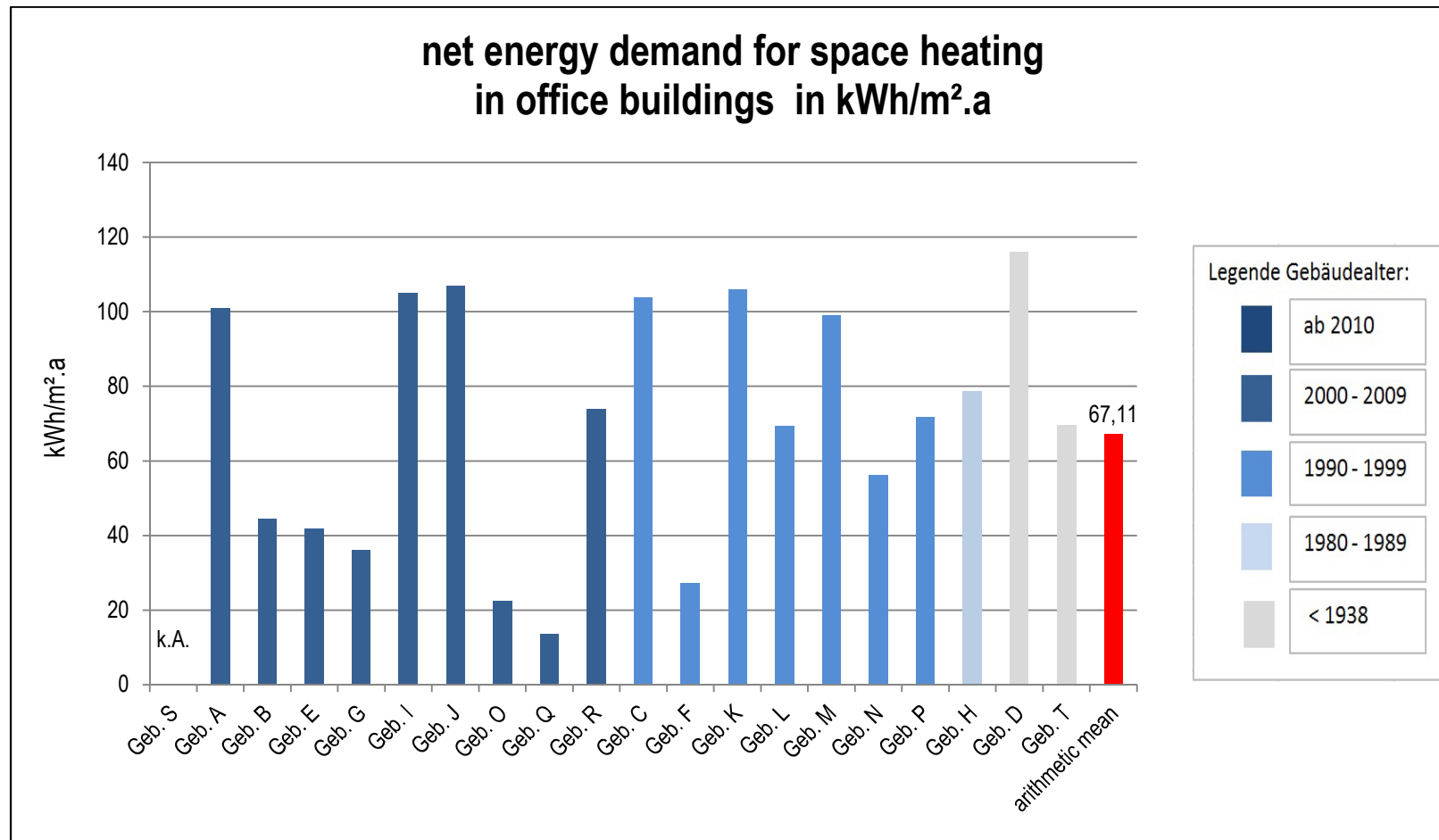
End energy demand by utilisation in percent



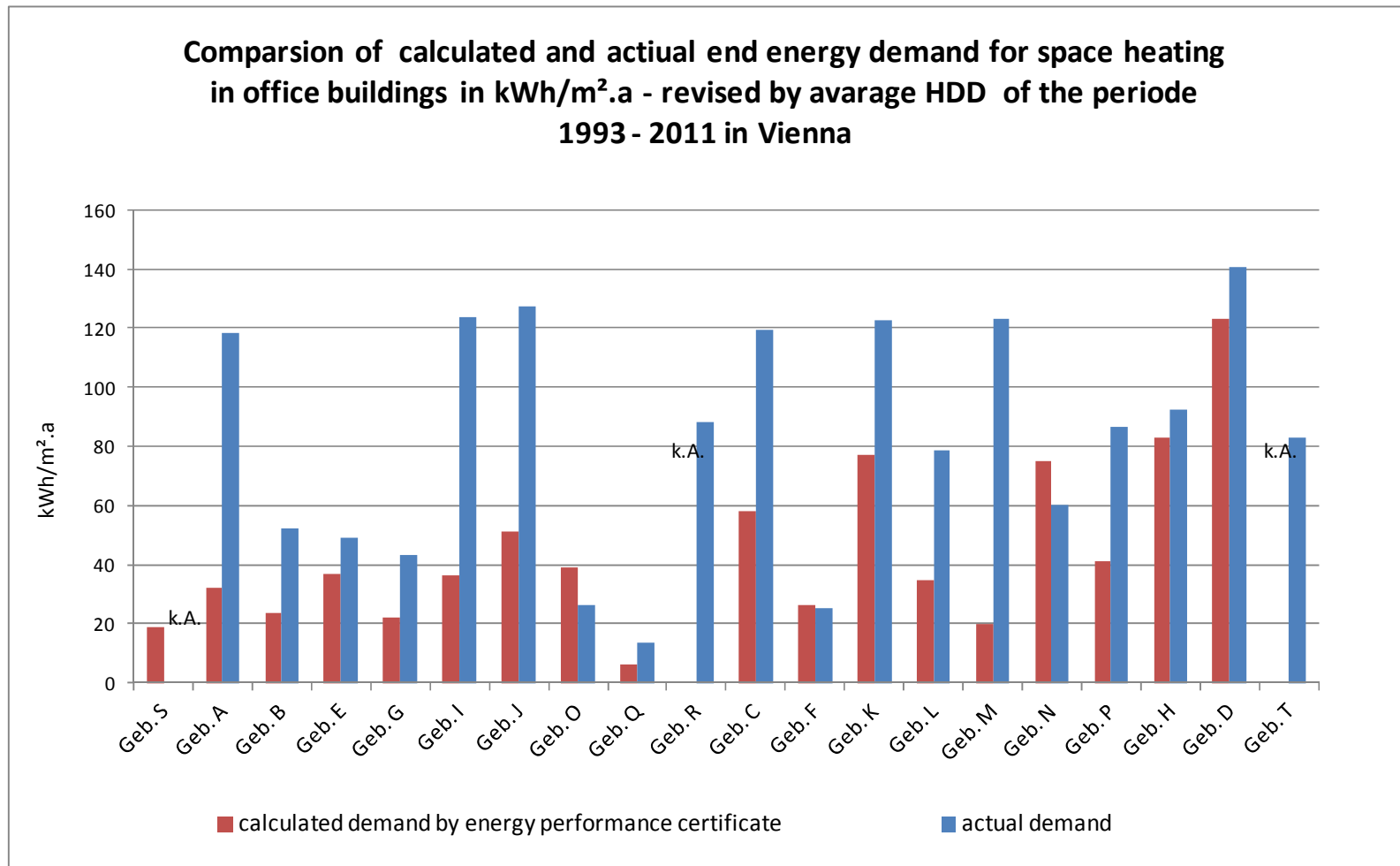
End energy demand by utilisation in kWh/m².a



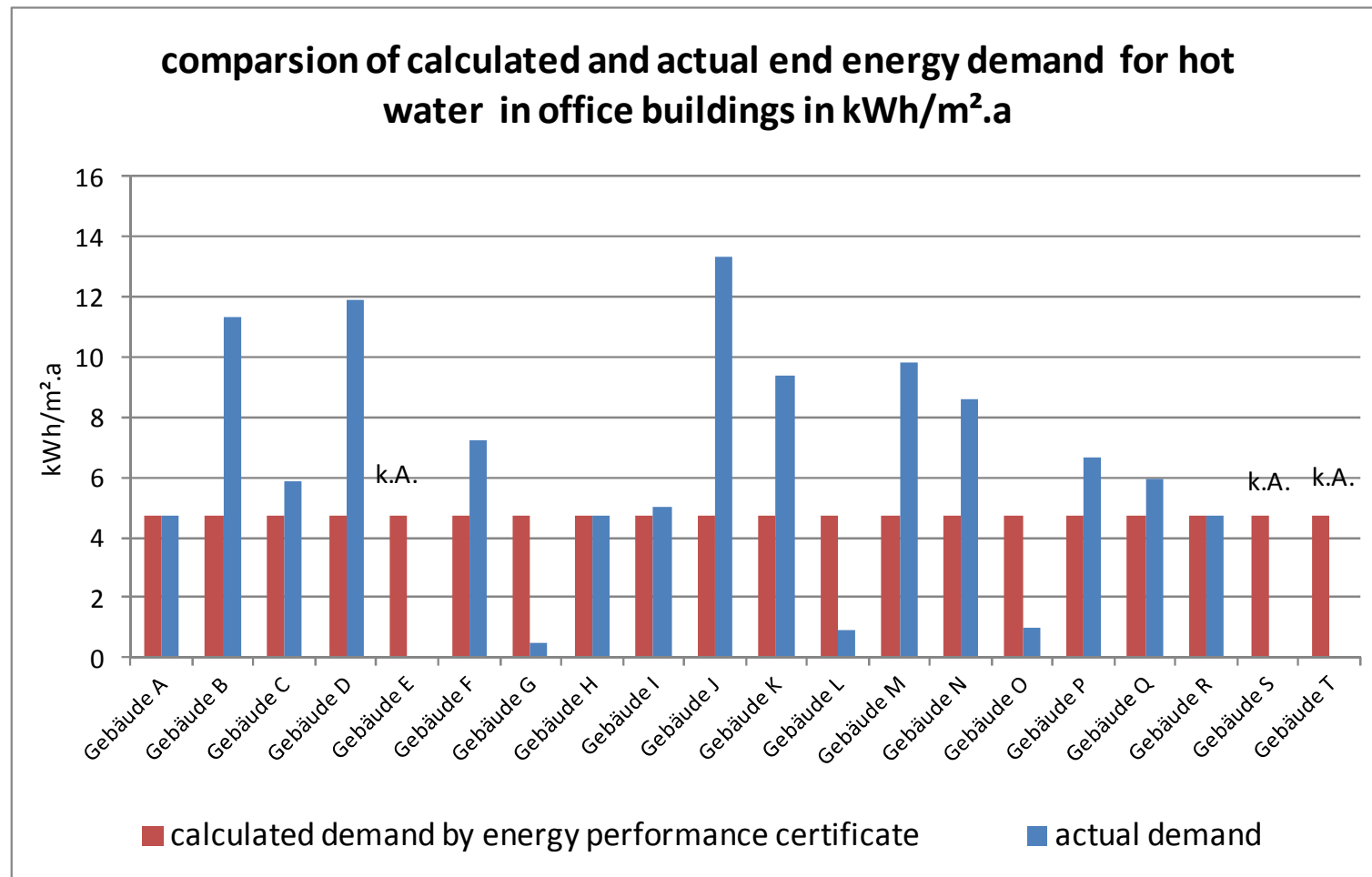
Net energy demand of office buildings in kWh/m².a



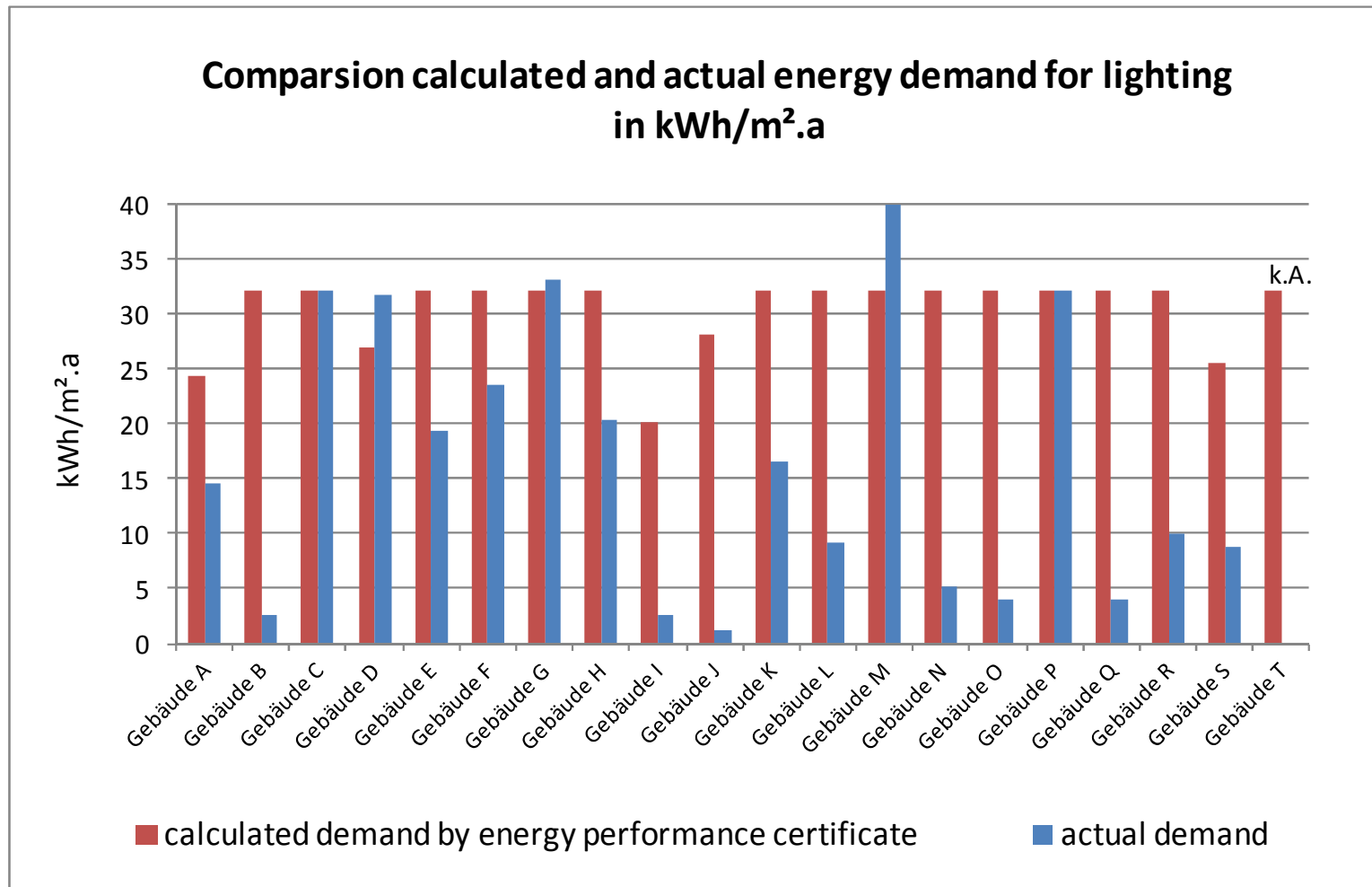
Comparison calculated and actual energy demand



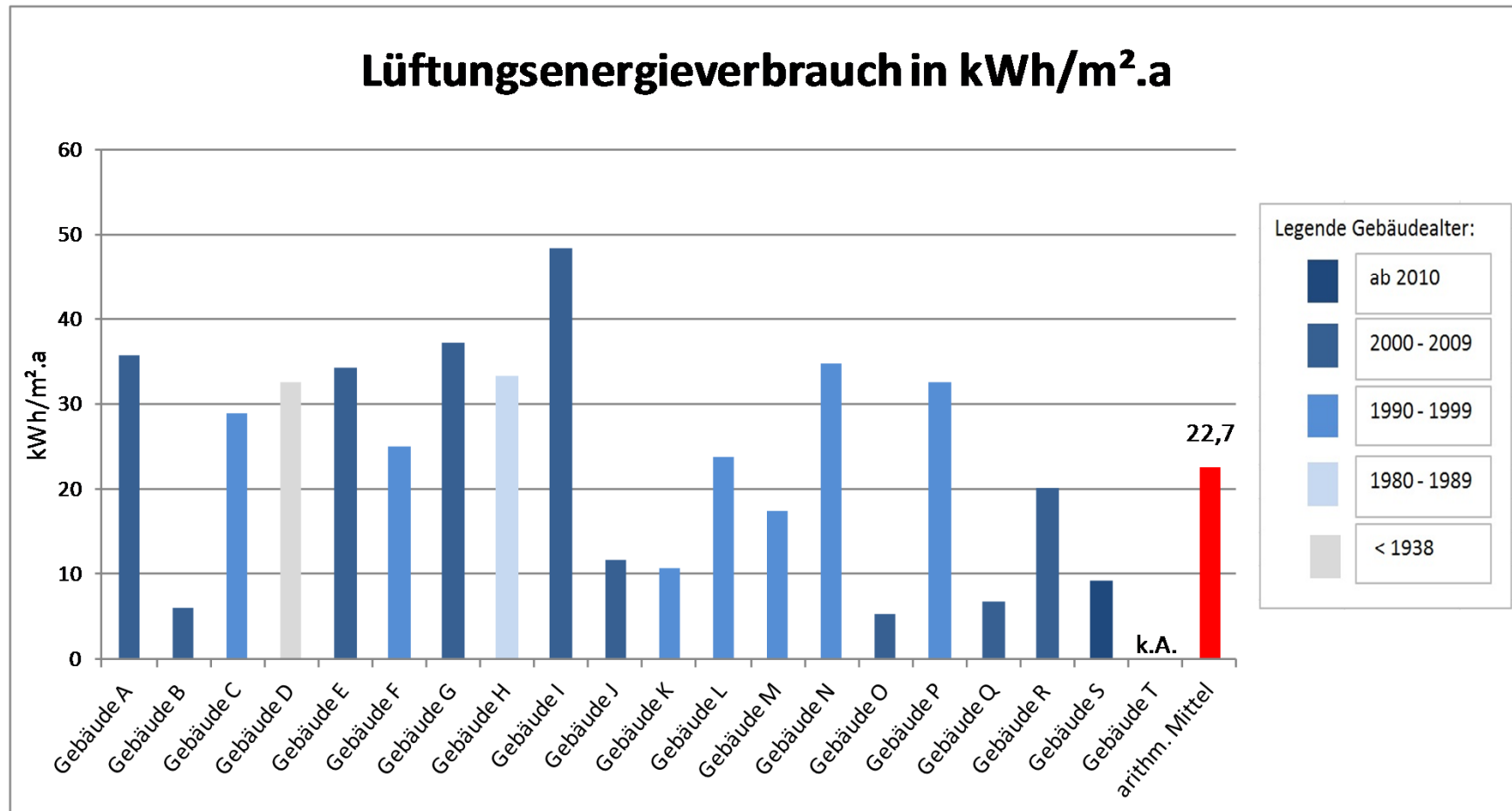
Comparison calculated and actual energy demand



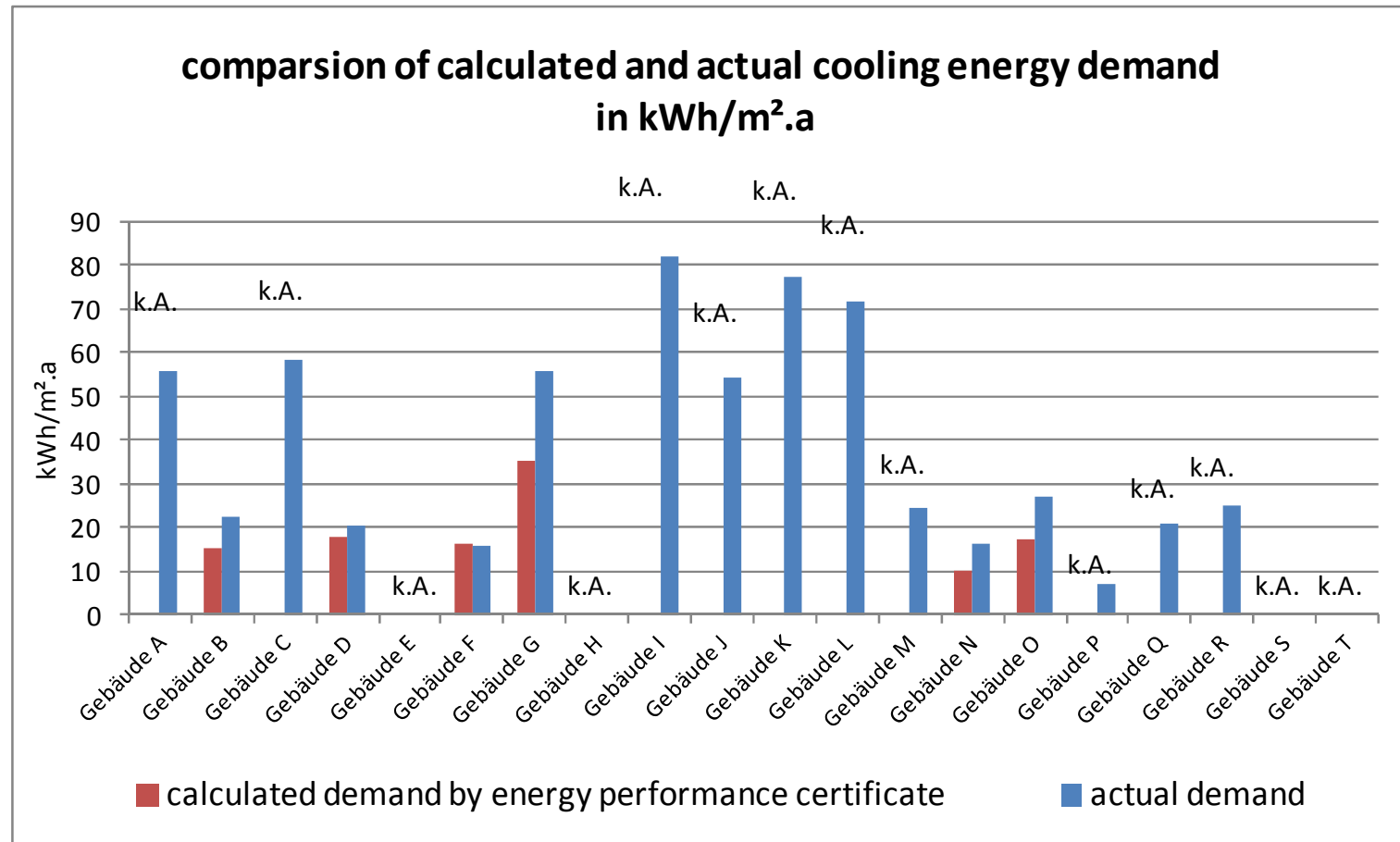
Comparison calculated and actual energy demand



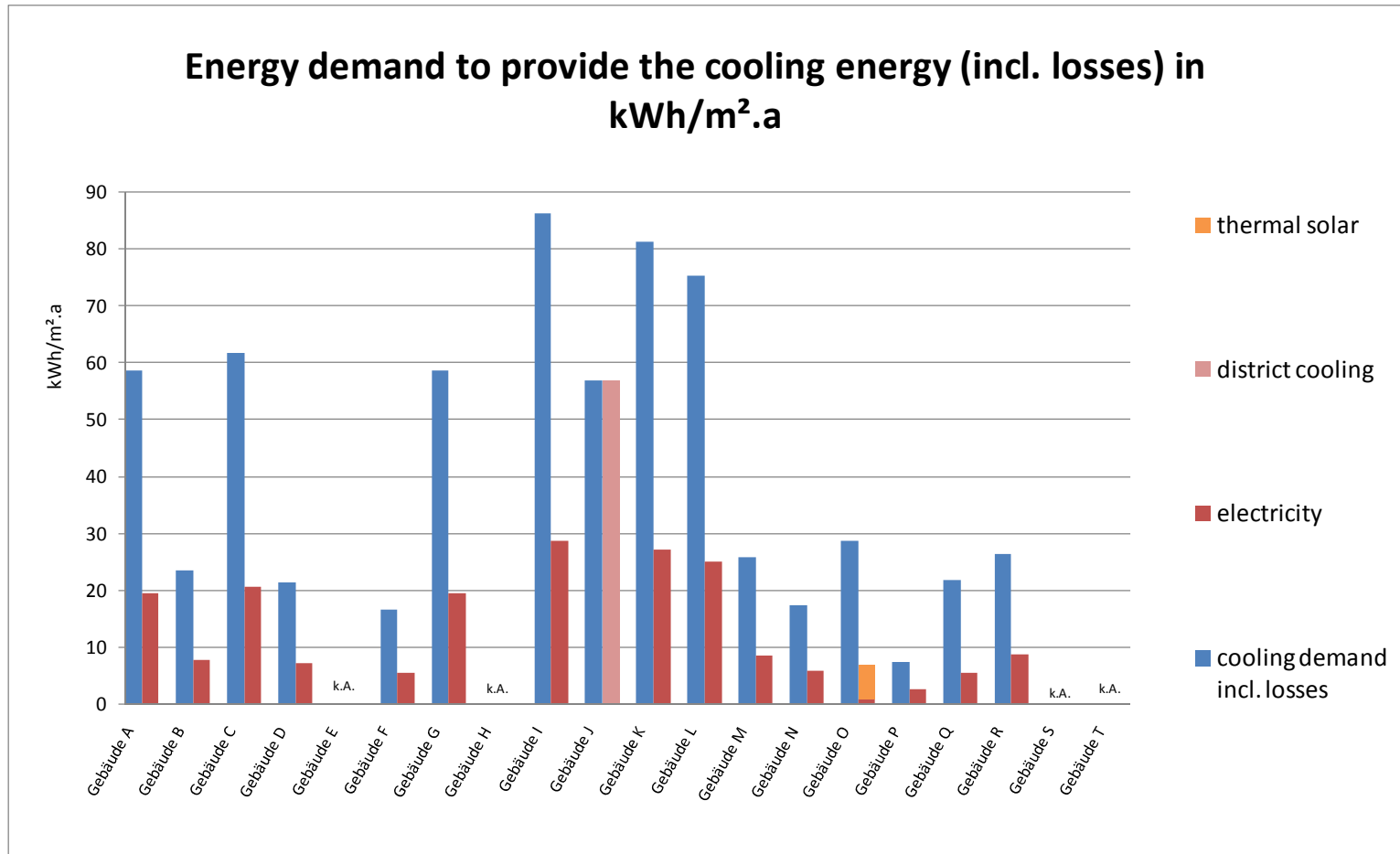
Energy demand for ventilation in office buildings



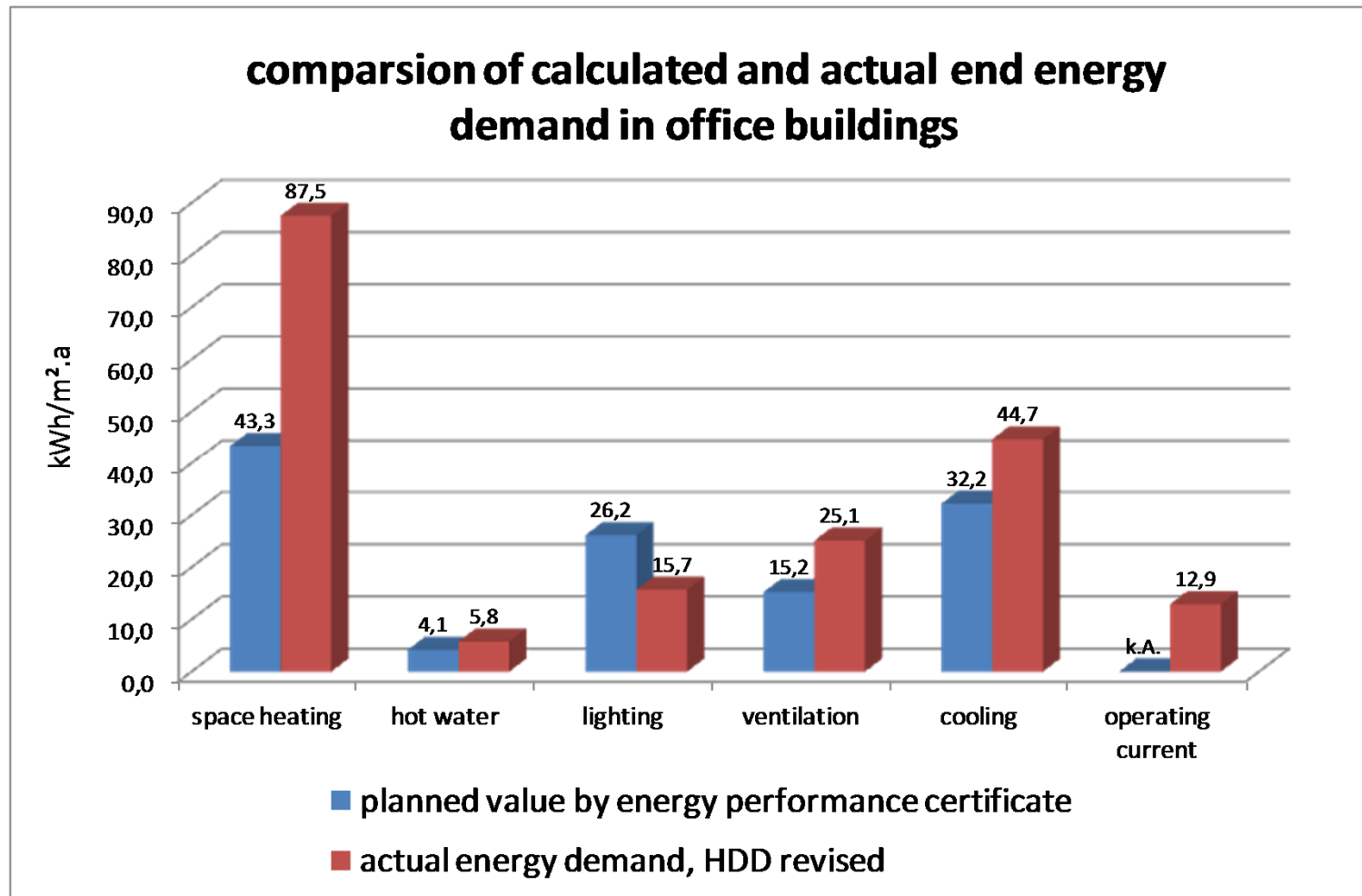
Comparison calculated and actual energy demand



Comparison calculated and actual energy demand



Comparison calculated and actual energy demand



Main outcome



- **Space heating:**
 - ◆ Office buildings need double amount of energy than calculated in energy performance certificates
 - ◆ Space heating requires 50% of the total energy demand (87 kWh/m².a space heat.)
- **Ventilation: high saving potentials** (due flexible volume flow according actual need)
- **Cooling:** saving potential by using ground/surface water and soil
actual mainly systems with seasonal performance factor 3, alternatives: 30
- **User behaviour: high saving potential**
 - ◆ Quotation of a technician: „We are using the latest efficiency technologies, but the user are not prepared for it and often they are overstrained“

Conclusions



Reasons of deviation

- **Energy performance certification not accurate**
- **Space heating: actual temperature 22-23°C instead of 20°C (15-30 %)**
- **User behaviour, behaviour of external services** (cleaning, security, ..)
- **Suboptimal HVACR adjustments**
- **Communication problems:** between user, technical inhouse department, outsourced technical services, further service companies ,
- **Cost/benefit:** costs occur in one department, savings in other department
-

Conclusions



High saving potentials by

- Improving communication between all stakeholder (e. g. external service companies)
- Improving the decision making process regarding energy saving measured („lost in the jungle“)
- Profiting by energy cost savings
- Information and awareness building of user



Examples user behaviour



Kindergarden, complete refurbishment, sunblind fixing defect, non stop lighting,
30 percent more energy

Examples user behaviour



Kindergarden, complete refurbishment, Dec. 2014 heating regulation by windows. Non insulated heating pipes. 20 % more heating energy.

Examples responsibilities, decision making process



Train station Sept. 2014

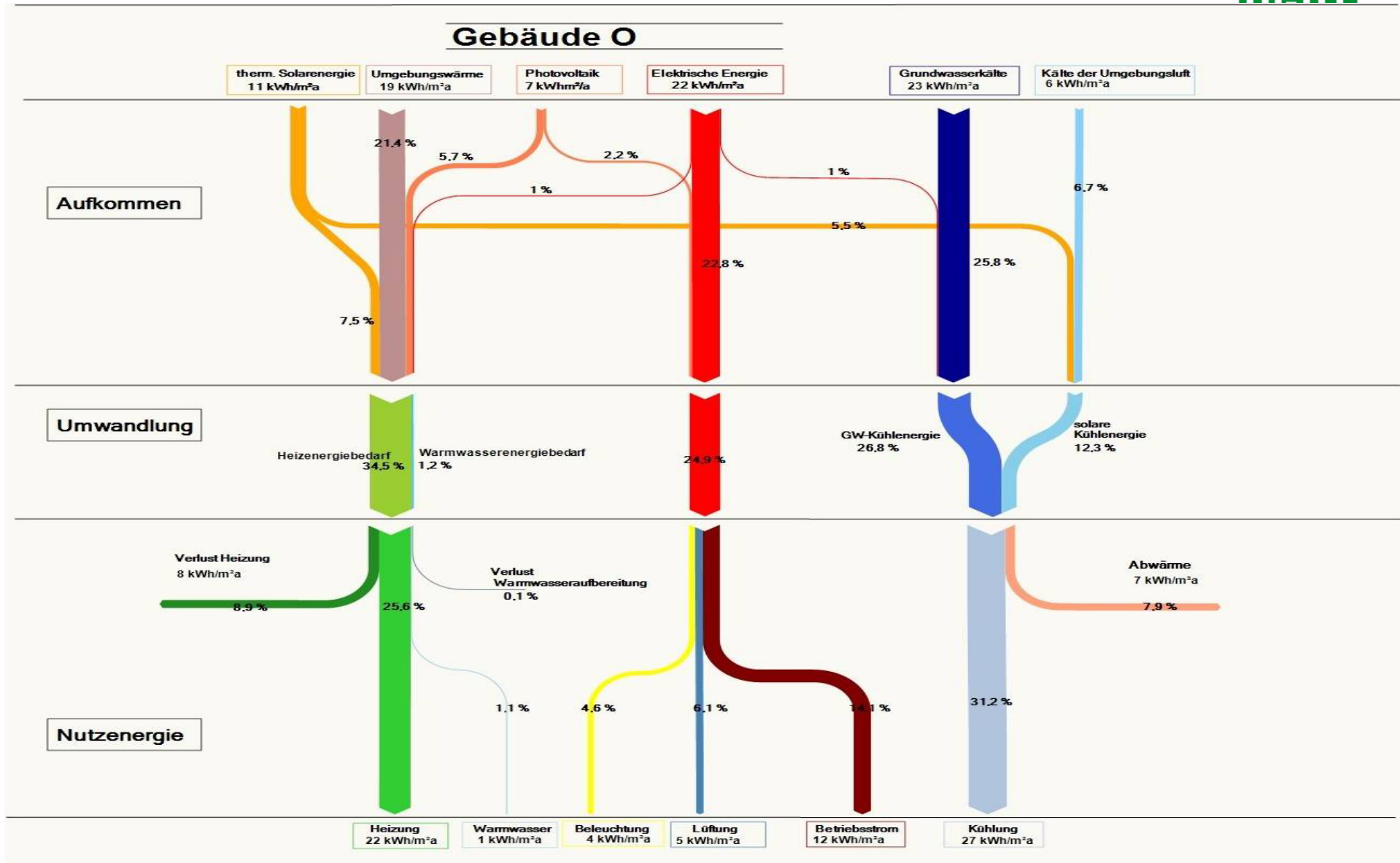


Train station July 2015

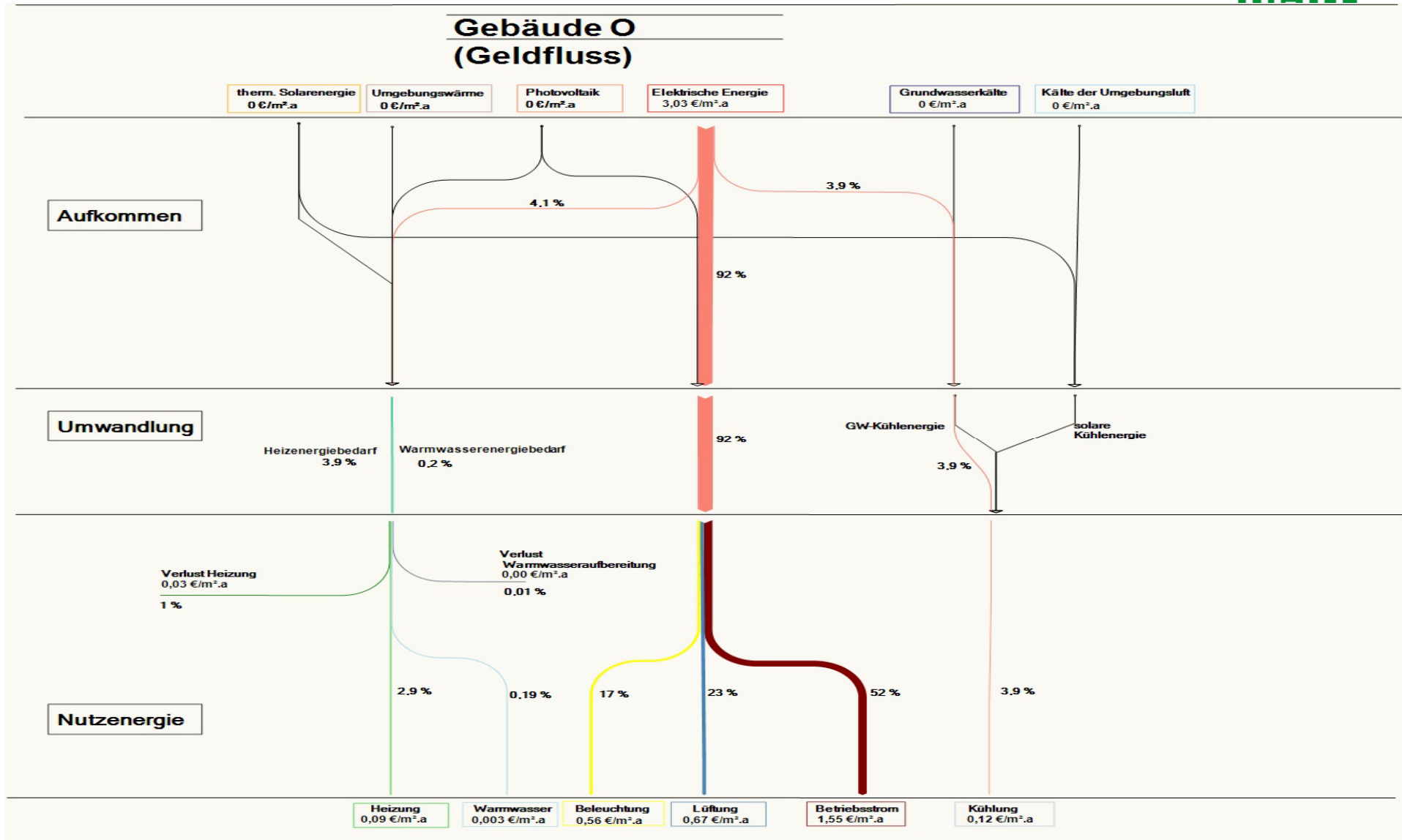
Train station in Lower Austria, lighting of parking place non stop. 12 tubes a 40 Watt
a 3,000 h/a = 1,440 kWh/a
35 percent more energy demand

different departments responsible for decision at ÖBB

Sankey-building O „kWh“ (Highlight)



Sankey-building O „money“ (Highlight)

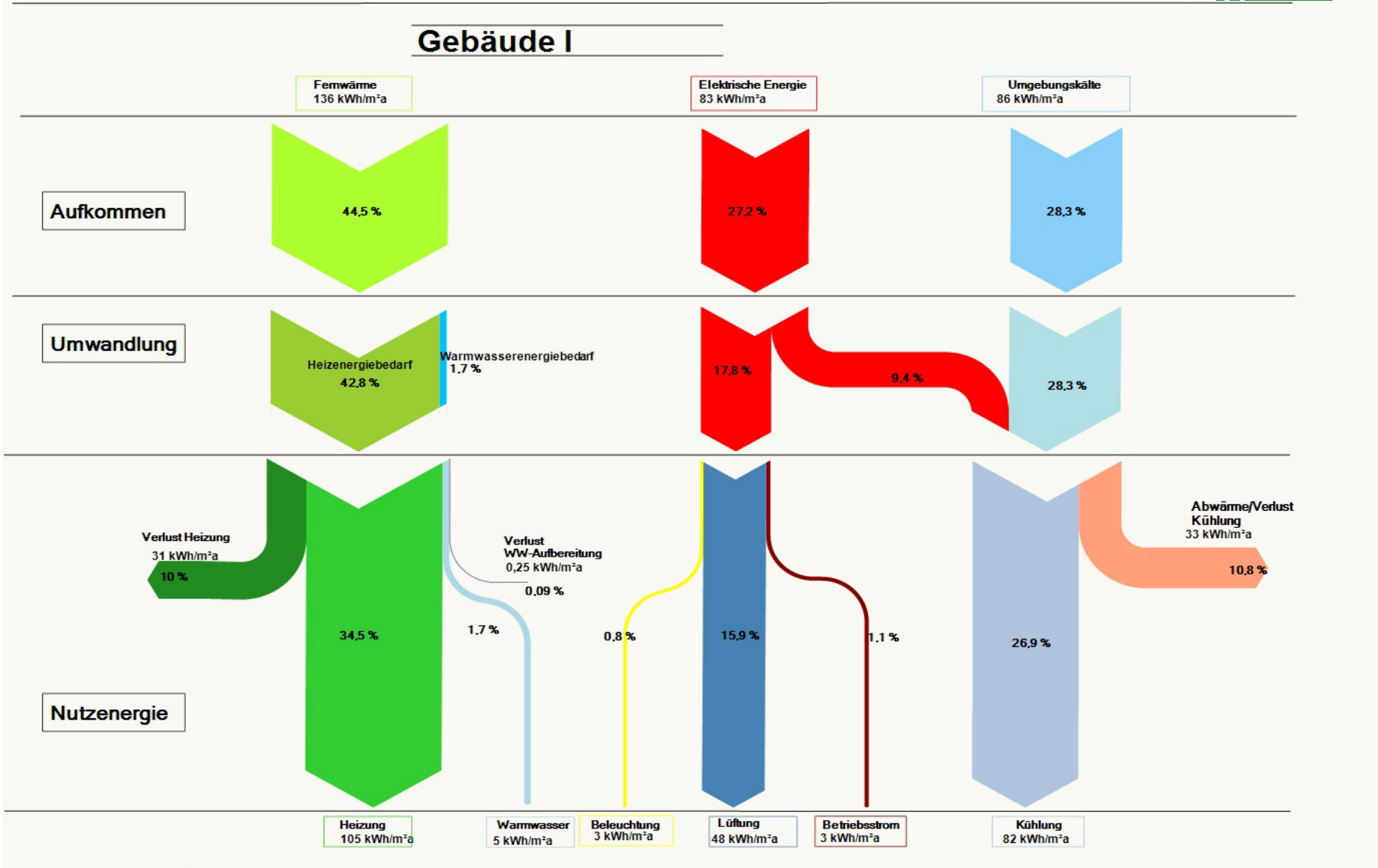


Die Kosten wurde auf Basis folgender Preisannahmen errechnet:
 • Strom 140 €/MWh

Sankey-Gebäude I „kWh“ (Bürogebäude Lowlight)



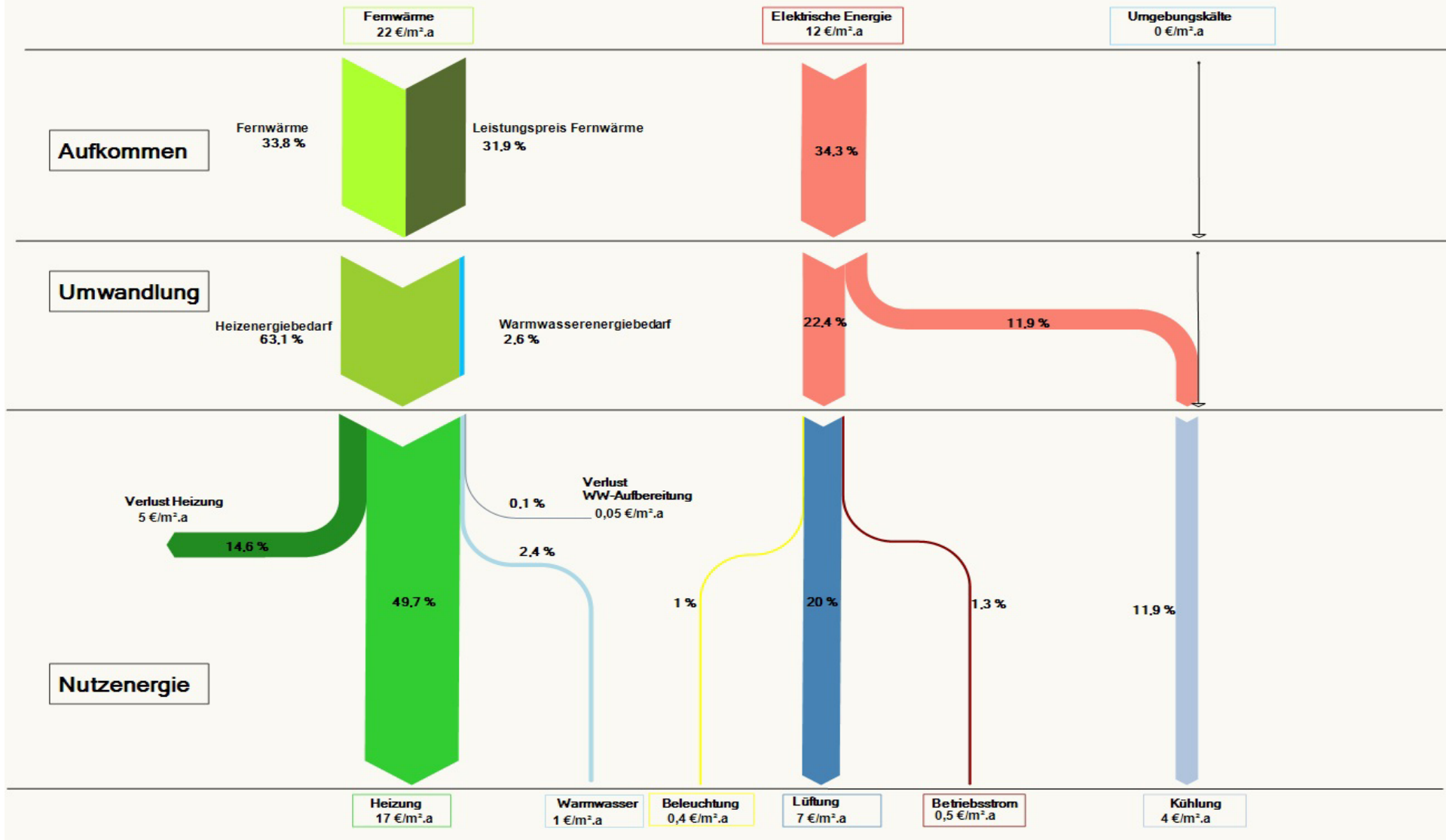
Gebäude I



Sankey-Gebäude I „Geld“ (Bürogebäude Lowlight)



Gebäude I



Annotation cost calculation in sankey diagramm



Sankey-building O „money“ (office building highlight)

Cost calculation based on following assumptions:
electricity costs 140 €/MWh

Sankey-Gebäude I „money“ (office building lowlight)

Cost calculation based on following assumptions:
electricity costs 140 €/MWh

District heating 85,15 €/MWh (data year 2013) plus
1x annual € 71.137.- (charge for power demand)

Reasons for heat energy exceeding – your estimations?

