web-based method to generate specific energy consumption data for the evaluation and optimisation of building operation

Andreas Wagner, Mathias Wambsganß, Sabine Froehlich

project partners:

- German Railway Track Infrastructure (DB Netz AG), Frankfurt a. Main, Germany
- University of Karlsruhe, Department of Architecture, Building Physics and Technical Building Services

funding:

- 50 % German Ministry of Economy and Labour
- 50 % German Railway Track Infrastructure (DB Netz AG)

Bundesministerium für Wirtschaft und Technologie

DB

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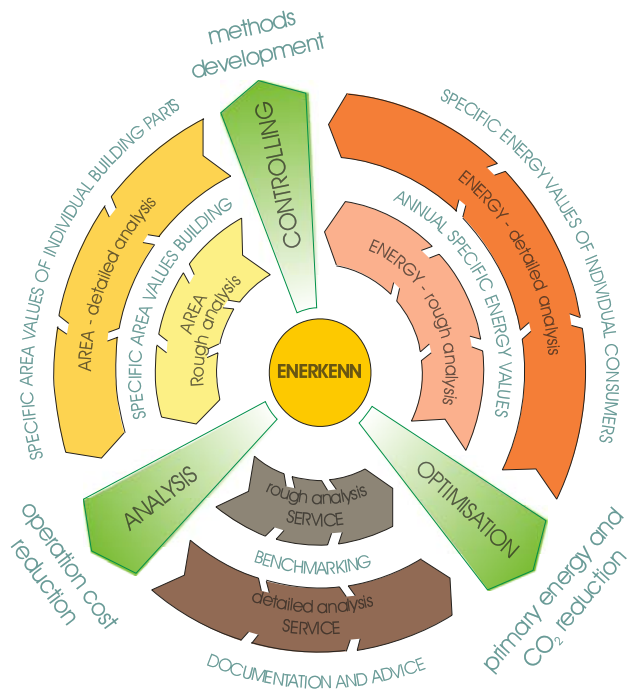
motivation

- very high potential for the reduction of CO_2 emissions in existing buildings
- insufficient knowledge about energy consumption and specific data especially in large building stocks
- user complaints and energy consumption are rarely considered in building operation

goals

- development of an economical method to improve the building operation
- reduction of energy consumption and operation costs as well as ensuring a high work space quality
- usage of the internet: data transfer, data visualisation, user survey, communication, project documentation



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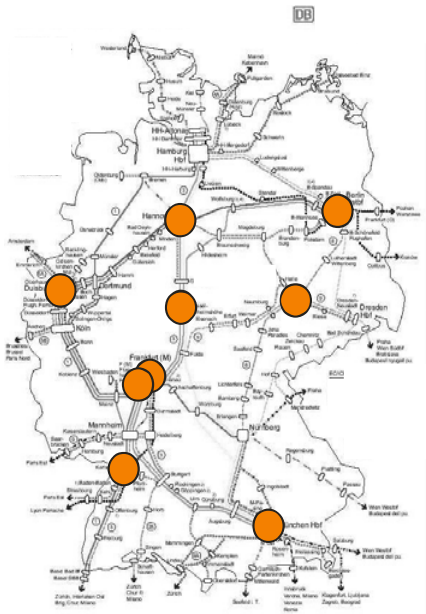


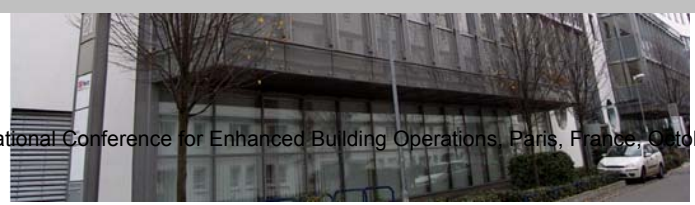
analysed buildings DB Netz AG

	A	B	C	D	E	F	G	H	I
year of construction	1998	1996	1996	1995	1996	1997	1970 restoration & extension 2000	1997	1998
utilisation 10-12 h/d 24 h/d	administration control rooms	administration control rooms garage	administration control rooms garage	administration control rooms	administration control rooms	administration control rooms	administration control rooms	administration garage	administration garage
number of floors	7	6	9	9	6	6	6	16	6
number of basement floors thereof	1	1	2	1	1	0	1	2	2
gross volume [m³]	113.454	78.239	96.245	101.473	76.019	105.312	93.188	77.885	26.579
gross floor area [m²]	27.806	27.321	28.008	27.371	21.817	27.776	23.986	31.439	7.681
heated net floor area [m²]	24.647	20.962	19.349	23.128	18.251	24.304	21.134	20.883	4.551
number of working places 2001	750	718	666	649	692	869	590	735	150







characteristics of the chosen buildings:

- all buildings built between 1995 and 2000
- leased office buildings
  (identical guidelines for building operation)
- high technical building equipment, partly airconditioned and 24 h operation time
  (high electricity demand)

→ **good comparability in age, size and use**

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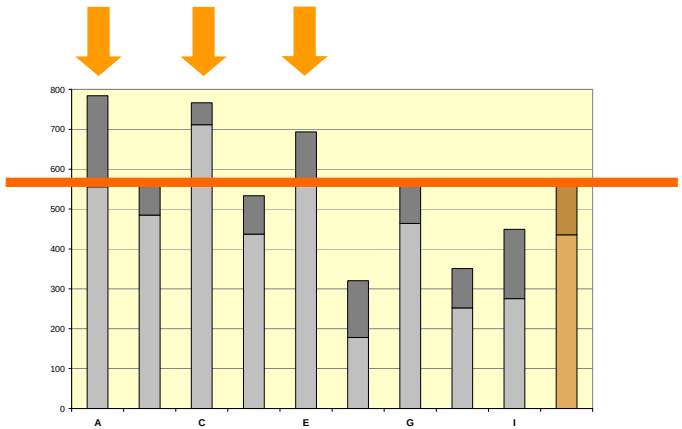
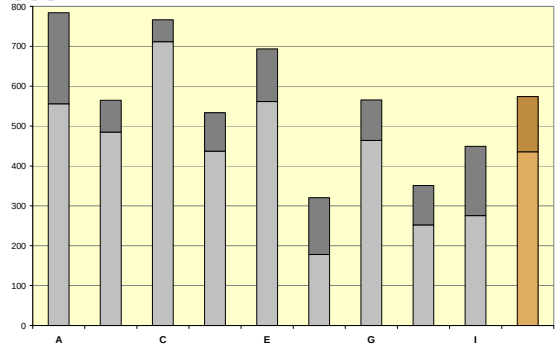
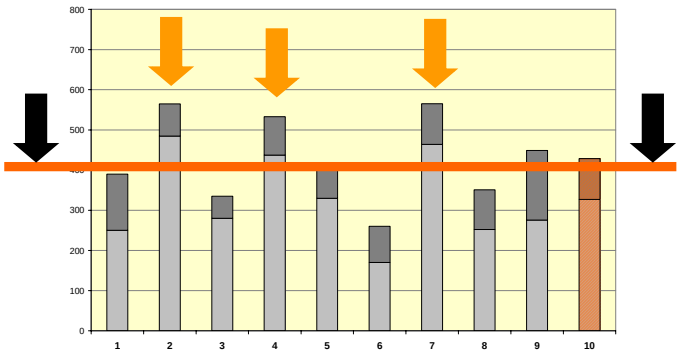
benchmarking and selection





rough analysis

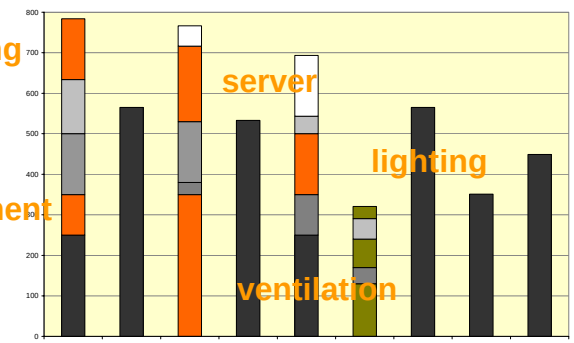
benchmarking and next selection



optimisation

detailed analysis

next detailed analysis



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data acquisition

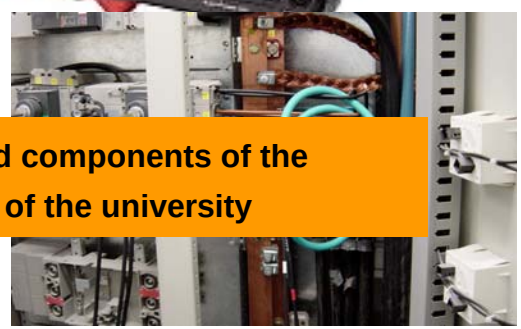
weekly readings

- electricity meters
- heat meters
- gas meters
- water meters
- meters counting operating hours and starts

regular readings of the meters which are already installed in the buildings - recorded by the buildings‘ technicians

temporary measurements

- logger recordings of indoor climate data
- measurements of electricity consumptions
- measurements of illuminances



short-time measurements on selected components of the technical equipment - by employees of the university

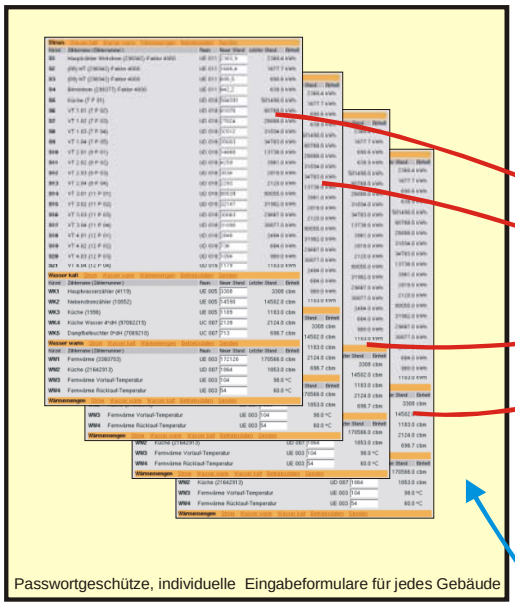
existing meters in the buildings

- number of meters 16 - 47 per building
- main meters for electricity, heat, gas, water
- additional 13 -40 meters for monitoring the consumption of various building parts or technical equipment
- unequal distribution of meters in the buildings:

good distribution
- hot and cold water
- consumption in staff cantine/ kitchen

bad distribution
- electricity

online input form HTML/ PHP)



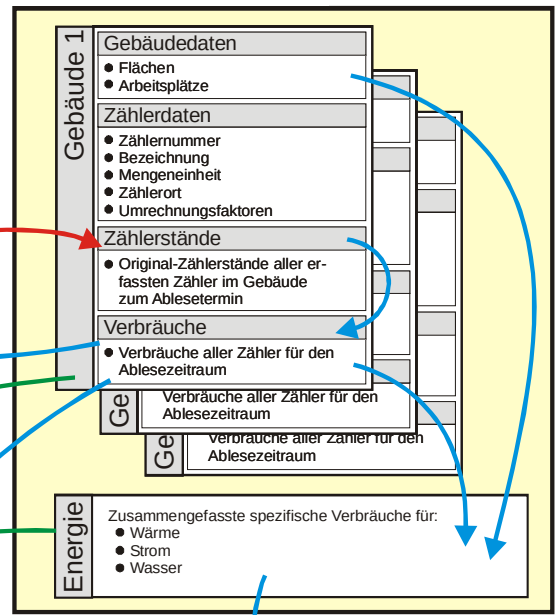
Passwortgeschütze, individuelle Eingabeformulare für jedes Gebäude

weekly meter readings

plausibility check (Perl)

- Negative Verbräuche
- Schreibfehler
- Zählerwechsel
- Große Verbrauchsänderungen (dynamisch)

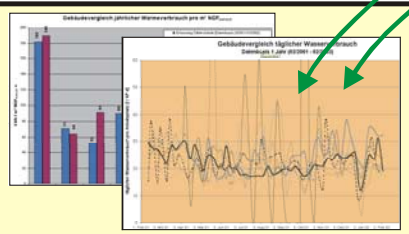
data base (MySQL)



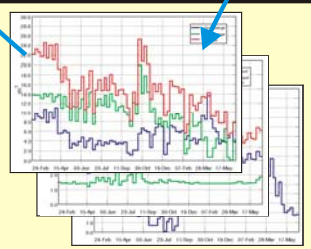
data management

data processing and visualisation via internet

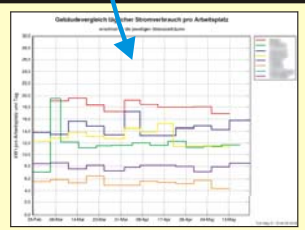
data processing



Erstellung von Webseiten mit z.T. anonymisierten Diagrammen zur Darstellung von Ergebnissen. Teilweise automatisierte Aufbereitung der Daten durch Perl-Skripte für manuelle Auswertung mit diverser Software.



Automatische Generierung von Protokollseiten mit Diagrammen der Verbrauchswerte der letzen Monate für die Gebäudemanager und als Mail an fbta-Mitarbeiter. (Software: Perl, Grace)



Berechnung von Flächen- und Arbeitsplatz-spezifischen Verbräuchen für Gebäude-vergleiche etc. (Software: Perl, Grace)

survey on work space quality with questionaire via intranet

relationship between users'
response and building operation ?

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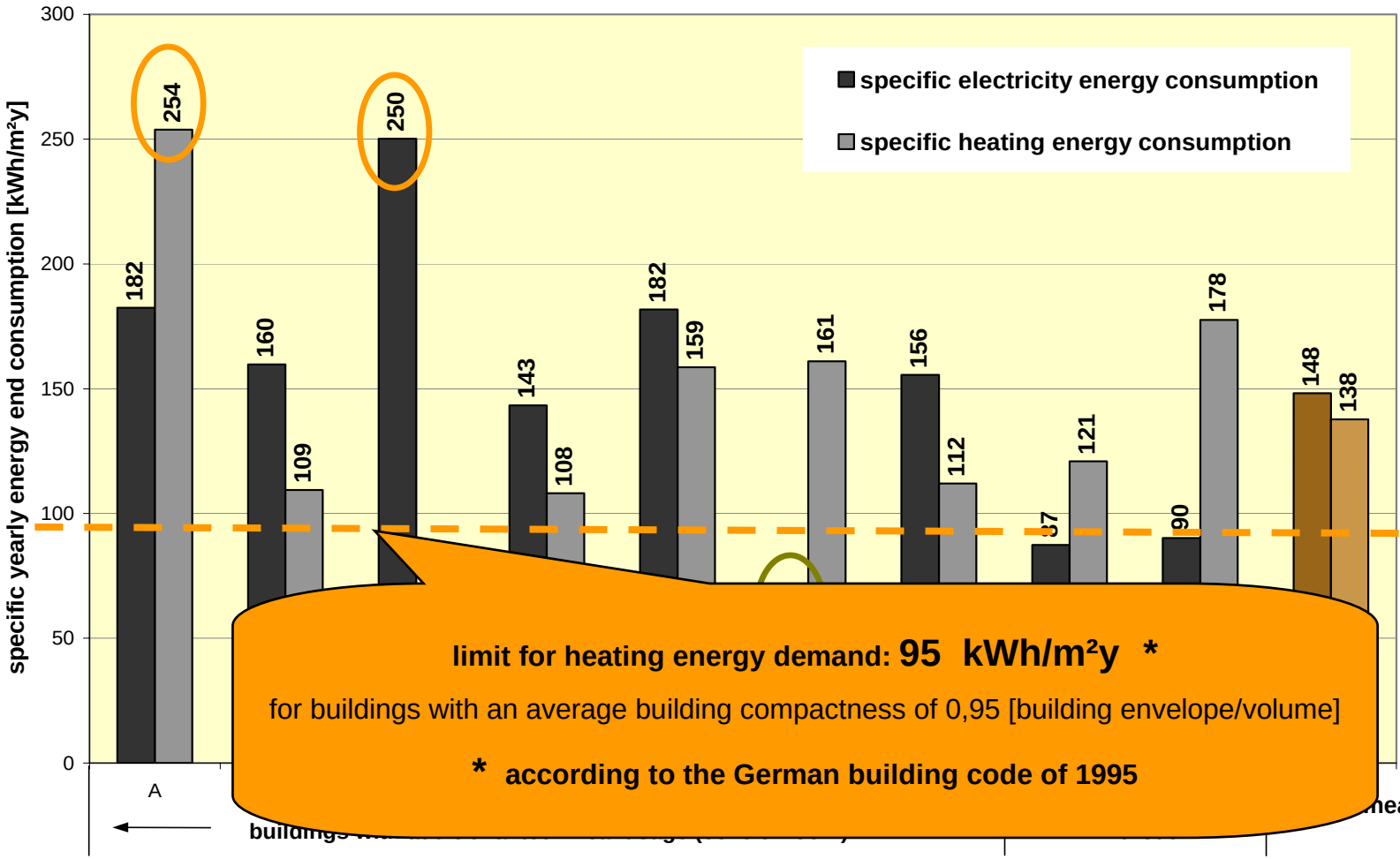
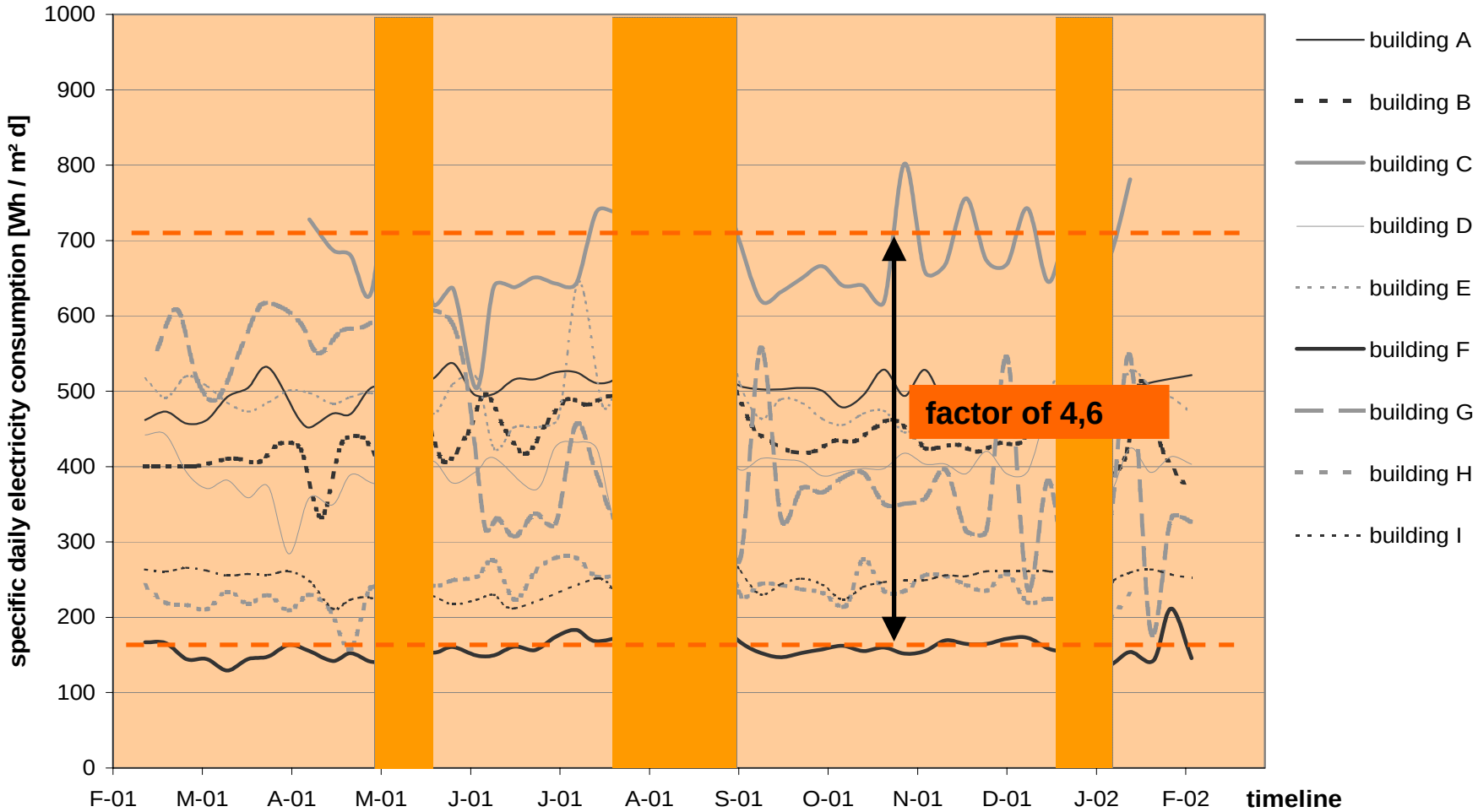
specific yearly energy consumption of electricity and heat

consumption related to the heated net floor area; data measured one full year: 02-2001 to 02-2002



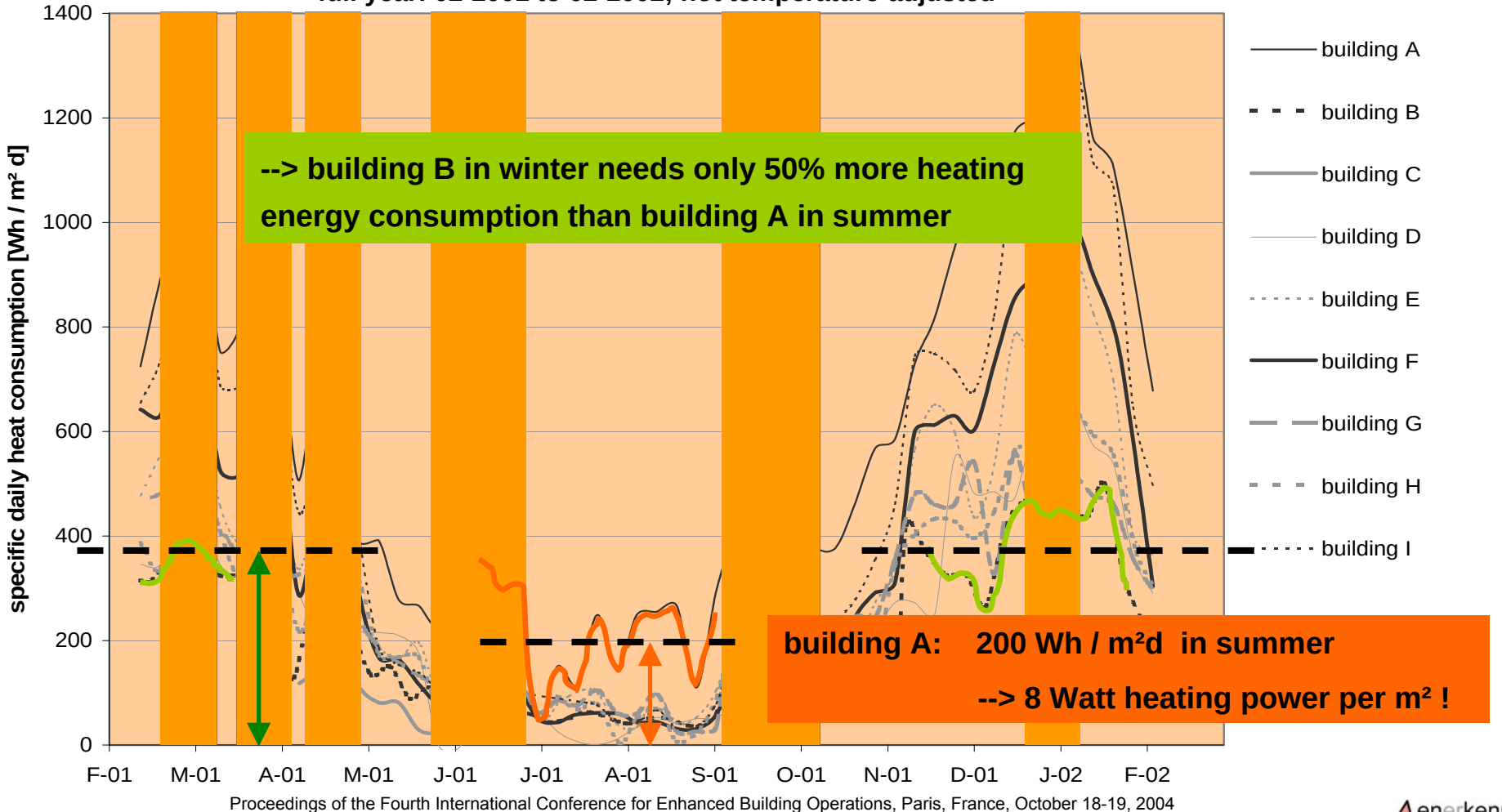
mean daily specific electricity consumption

consumption related to the heated net floor area; data measured weekly for one full year: 02-2001 to 02-2002



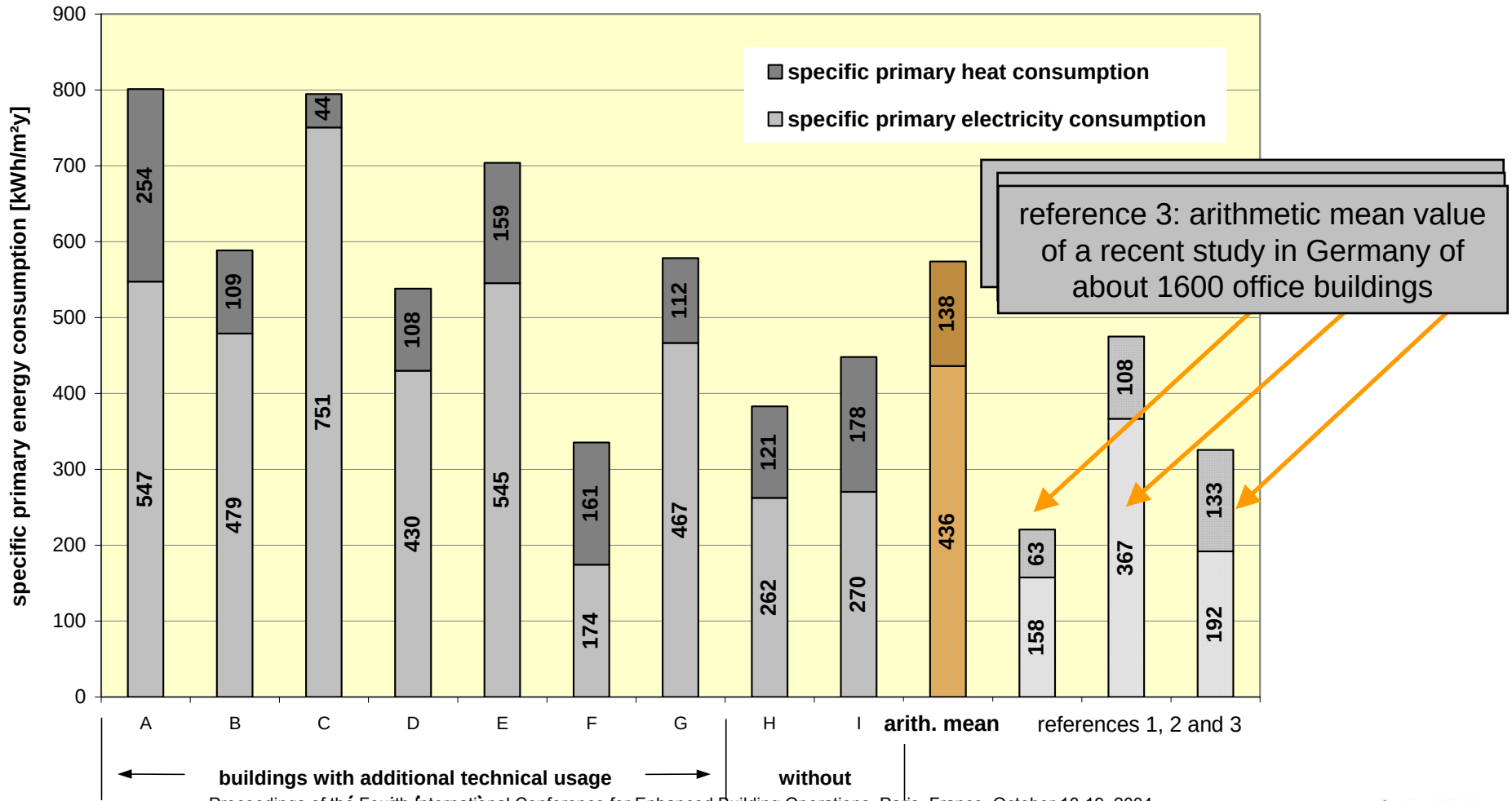
mean daily specific heat consumption

consumption related to the heated net floor area; data measured weekly for one full year: 02-2001 to 02-2002; not temperature-adjusted



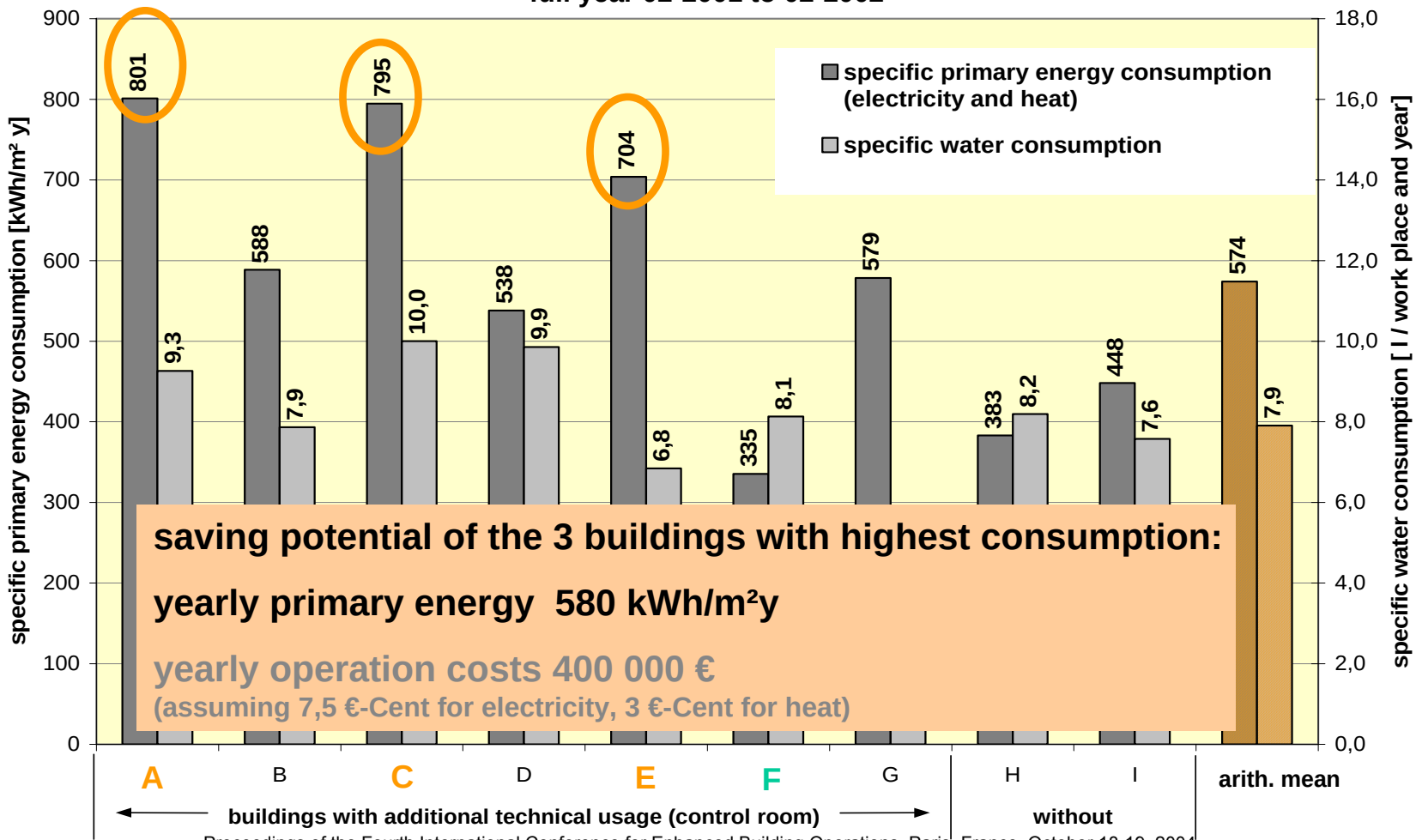
specific yearly primary energy consumption of electricity and heat

consumption related to the heated net floor area; data measured one full year: 02-2001 to 02-2002



specific yearly primary energy and specific yearly water consumption

energy consumption related to the heated net floor area, water consumption per work place; data measured one full year 02-2001 to 02-2002



saving potential of the 3 buildings with highest consumption:

yearly primary energy 580 kWh/m²y

yearly operation costs 400 000 €

(assuming 7,5 €-Cent for electricity, 3 €-Cent for heat)

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web-based method to generate specific energy consumption data for the evaluation and optimisation of office building operation

conclusions:

- fast generation of reliable specific building data (energy, water, areas)
- no investment costs for data acquisition or specialised software packages
- high automatisation: web-based monitoring and data management via data base
- optimisation targets: technical equipment, building operation and user behaviour

goal: **application on large building stocks**

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web-based method to generate specific energy consumption data for evaluation and optimisation of office building operation

contact: University of Karlsruhe

- wagner@fbta.uni-karlsruhe.de
- www.fbta.uni-karlsruhe.de

internet www.enerkenn.de

(in german language only)