Monitoring of Energy and CO_2 Savings

EMPOWER
Energy Monitoring, Regulation and Management

Almada, 25.10.2018
Dipl.-Ing. Tobias Timm

Climate Protection in Weserbergland: Challenge and Opportunity for the Future

- **predominantly rural region** with typical structural characteristics
- enormous challenges because of **demographic change**
- climate protection as **strategical instrument** for shaping the future

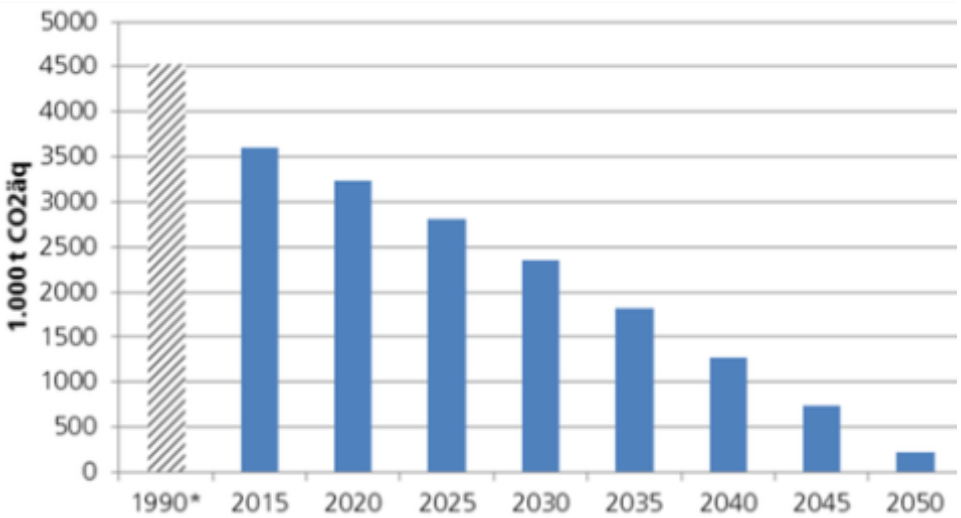
Masterplan 100 % Climate Protection

Excellence Initiative of Federal Ministry for Environment Protection

- 22 pilot municipalities and regions all over Germany
- 900 TEUR promotion 2016-2020

Political decisions in 2017:

- 95 % CO_2-reduction until 2050
- 50 % end-energy demand until 2050



Klimaschutzagentur Weserbergland
Motor for Realisation

- **activities are bundled** in the climate protection agency
- a successfull example for a **non-profit private-public-partnership**

public affairs

energy consultancy

engineering

Klimaschutzagentur Weserbergland shareholders

municipalities

- Landkreis Hameln-Pyrmont
- Landkreis Holzminden
- Flecken Aerzen
- Stadt Bad Münder
- Stadt Bad Pyrmont
- Flecken Coppenbrügge
- Gemeinde Emmerthal
- Stadt Hameln
- Stadt Hessisch Oldendorf
- Flecken Salzhemmendorf

municipal utilities

- Avacon AG
- Stadtwerke Hameln
- Stadtwerke Bad Pyrmont
- Westfalen Weser Netz GmbH

economy

- association for promotion

Energy Monitoring: Starting Situation

- municipalities have committed themselves to **ambitious climate protection targets**
- municipalities serve as important **role models**
- climate protection concepts evaluate **saving potentials > 30 %** in public buildings
- only few municipalities practice **municipal energy management (MEM)** systematically or have internalized its relevance
- **energy reports** are only generated irregularly
- especially smaller municipalities do not have the **relevant resources** (such as staff, know-how, financial resources to afford external staff) to implement MEM systematically and consistently

On behalf of:

Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety

European Climate Initiative EUKI

Municipal Energy Management

Municipal Energy Management

Starting Situation

- Buildings are responsible for 40% of energy consumption and 36% of CO_2 emissions in the EU. The building sector has a key function for achieving the climate protection goals.
- Activities on the municipal level are of significant importance. Only a few municipalities practice municipal energy management (MEM) systematically so far or have internalized its relevance.
- The nation-wide implementation of a systematic MEM can make an important contribution to the long-term lifting of existing saving potentials in the municipalities.

mem
Municipal Energy Management

www.euki-mem.eu

Project Tasks

- intensifying the cross-border dialogue and exchange of knowledge and experience on MEM
- demonstrating the benefits of MEM by introducing it to 60 municipal demonstration buildings across the target regions
- creating the personnel, organizational and technical prerequisites and capacities for the implementation of systematic and long-term oriented MEM in the target regions
- disseminating the knowledge gained during the project period across the EU

klimaschutz agentur weserbergland

SOFENA

KREA save · agency

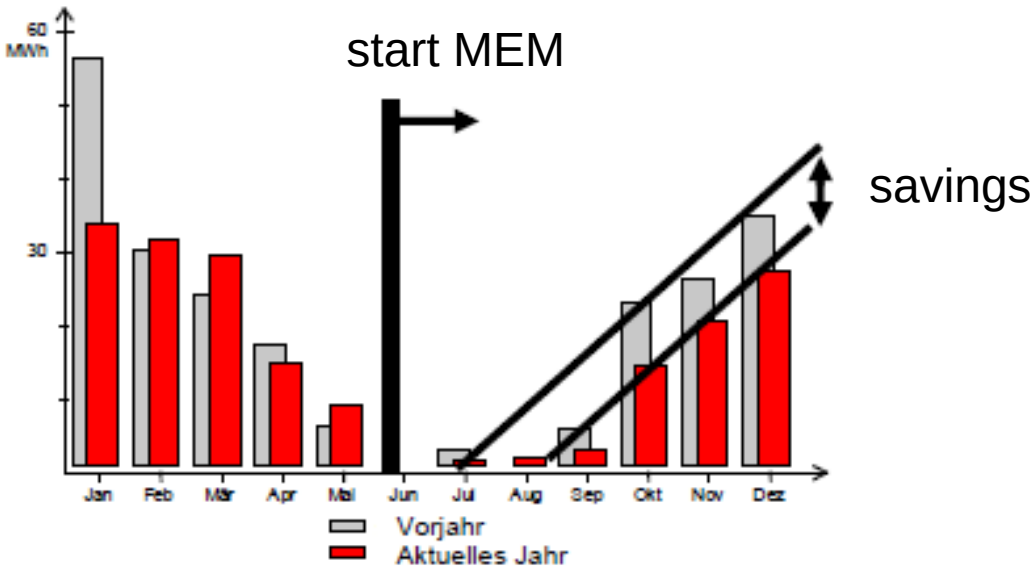
energap energetska agencija za Podravje

Project Duration

Oct 2017 – Feb 2020

Goals of Municipal Energy Management

- sustainable reduction of electricity, heat and water consumption
- reduction of costs
- reduction of CO_2-emissions
- optimization of building management and use
- sustainable modernization management



quick savings after optimization measures

Systemical Energy Monitoring and Controlling

- inventory of the current consumption meters and areas
- **monthly recording and evaluation** of all consumptions
- **continuous monitoring** of energy and water consumption
- **immediate notifications** about conspicuous excess consumption and information about possible repairs
- **clear illustration** for successfully implemented energy saving measures

noticeable additional consumption is detected immediately

Important Partners: Janitors

- monthly consumption - controlling

- feedback

- local inspection
- measuring/Data logger
- optimization

- trainings
- advice for (low-)investment measures and components

INM Software – Municipal Energy Management

Software for monthly energy monitoring

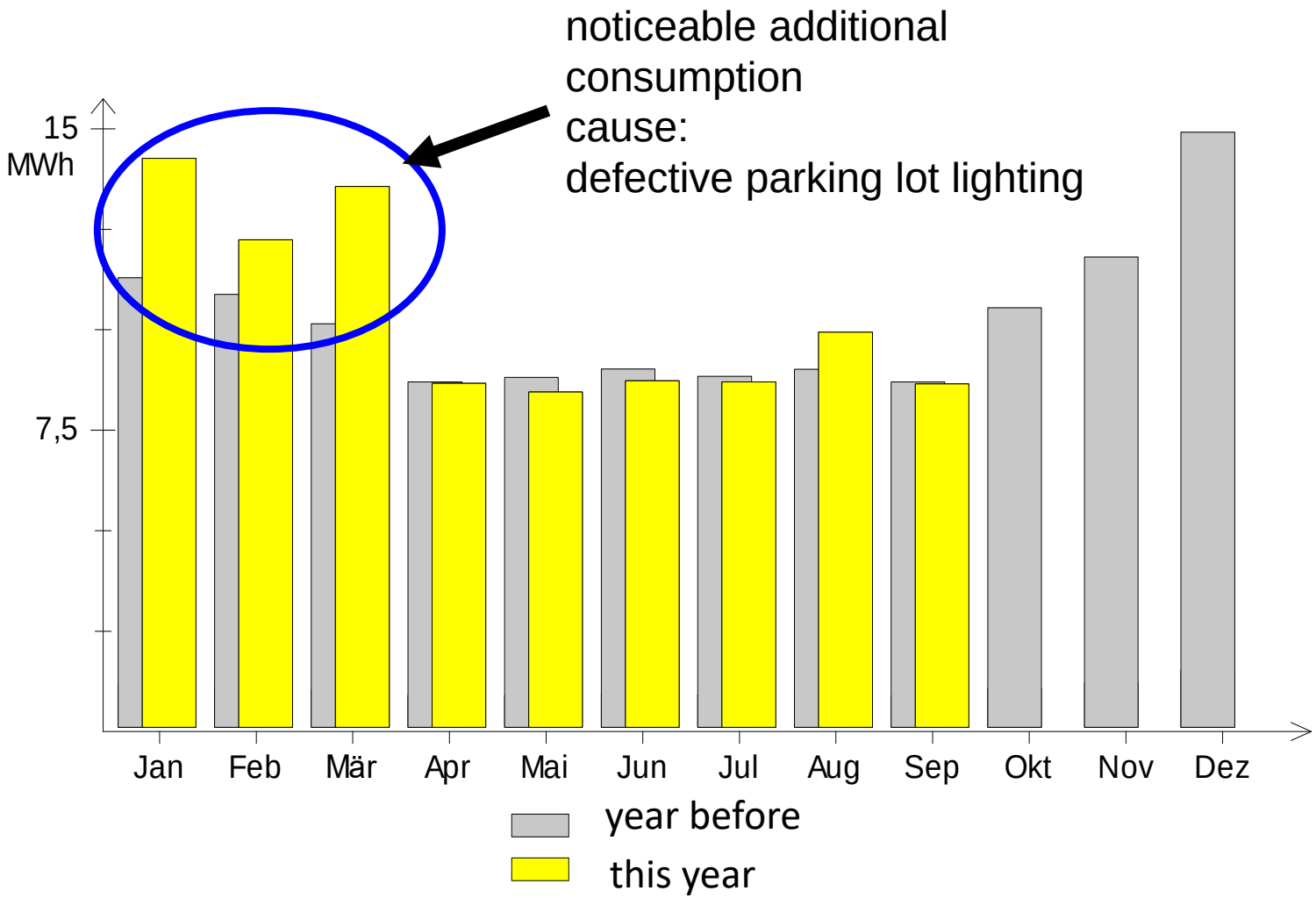
- **Web based**
- **Different accesses** for different utilisation (facility manager, administration, …)
- **values are displayed directly**

entering the values via mobile phone - App

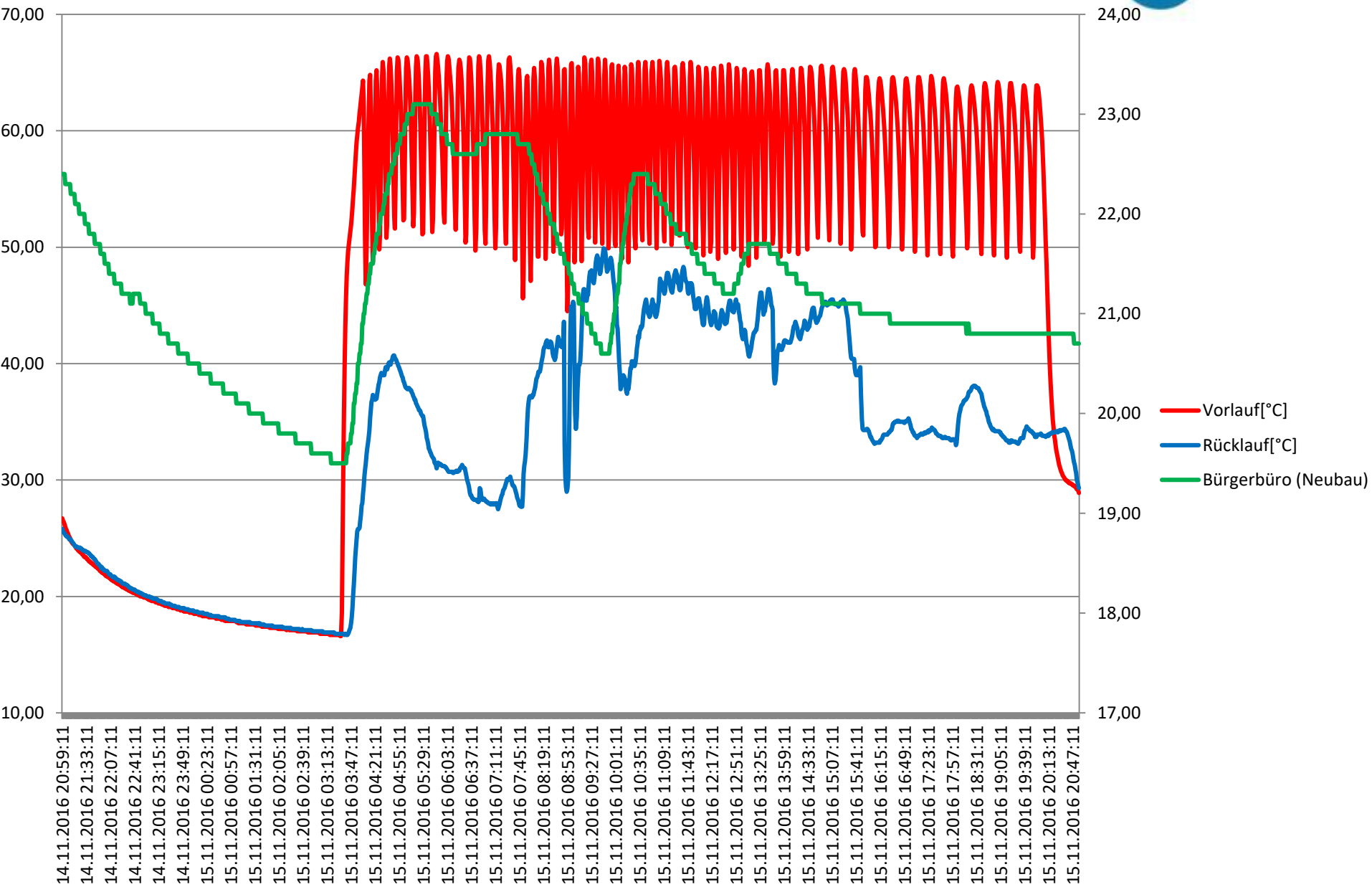
or

entering at the computer

Energy Monitoring and Controlling



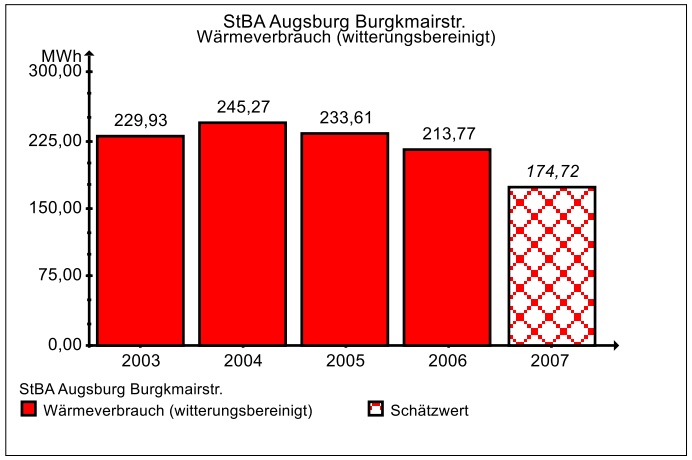
Mobile Meters for Optimizing Heating Systems

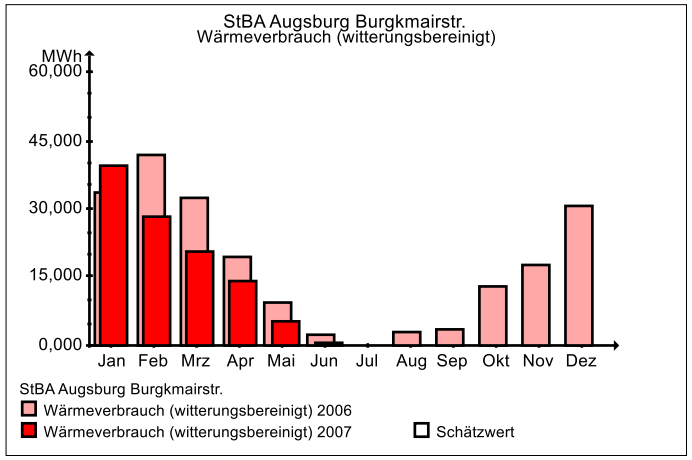


Regular Energy Reports

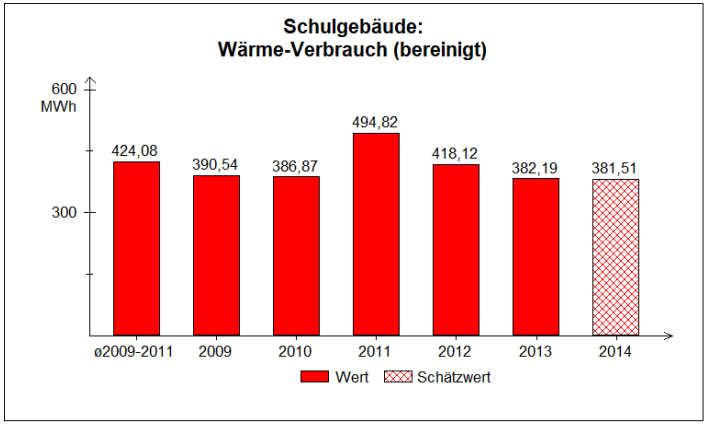
Preparation and updating of an annual energy report

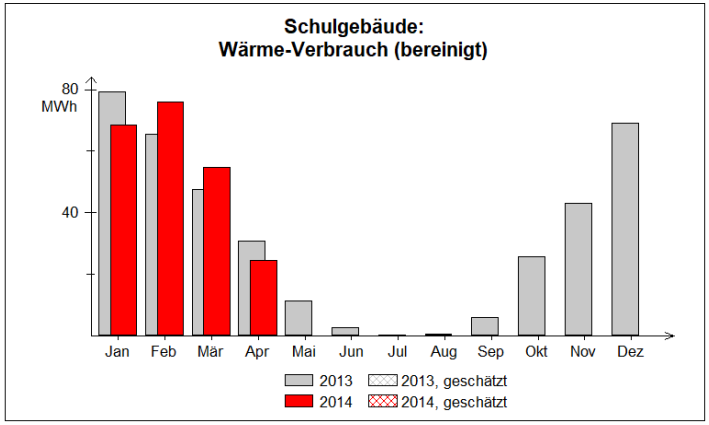
- consumption and CO_2 development
- cost development
- proposals for technical and organizational optimization



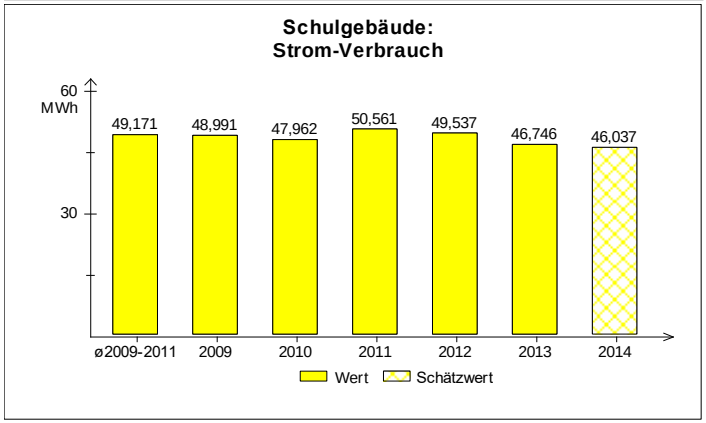


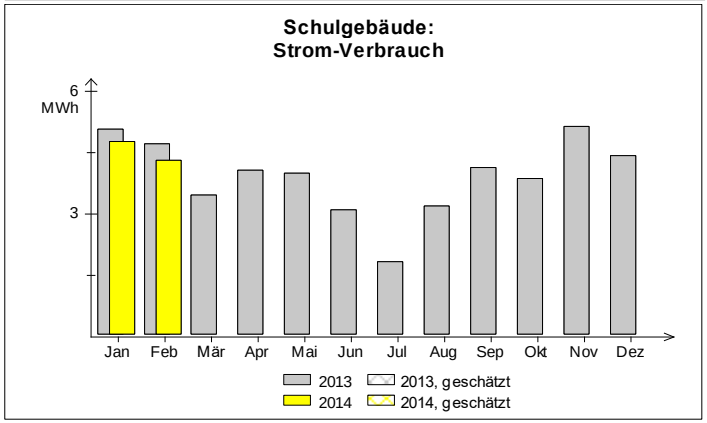
Short Monthly Reports for each Property (excerpt)



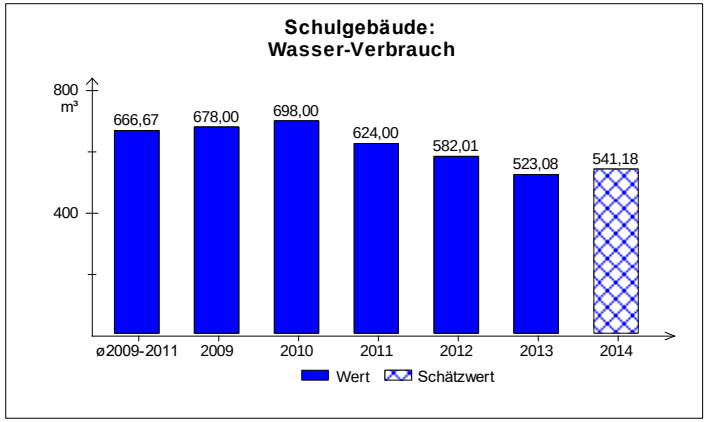


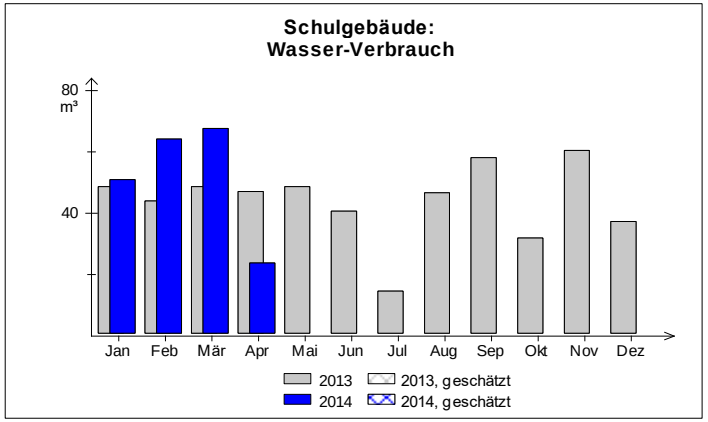
heat





electricity

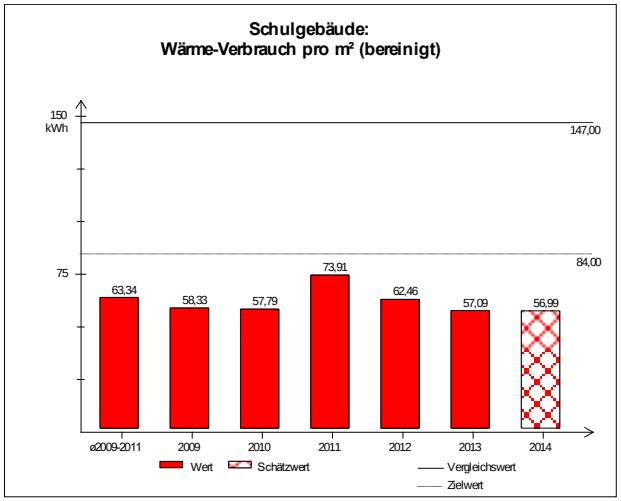


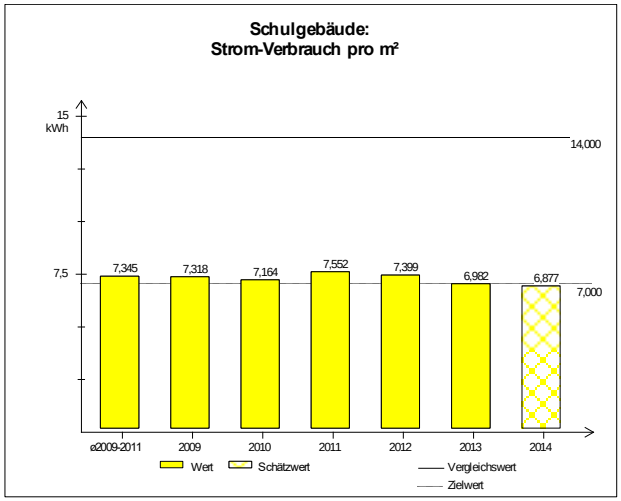


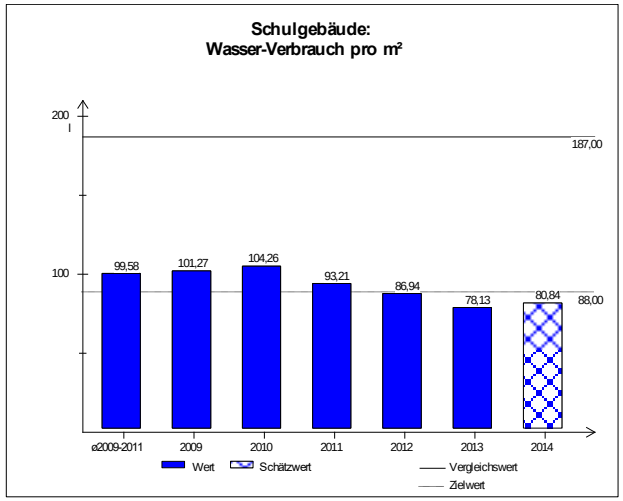
water

Detailed Yearly Report (excerpt)

consumption parameters

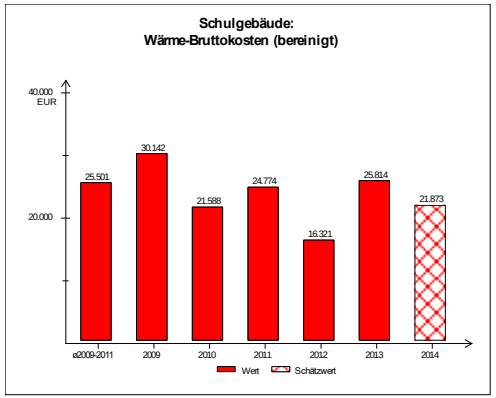


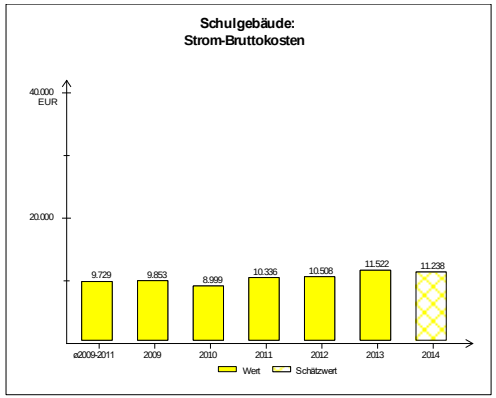


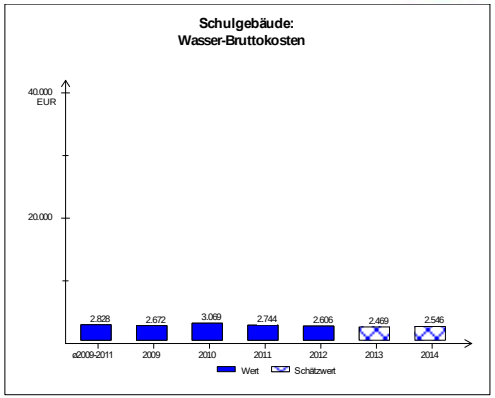


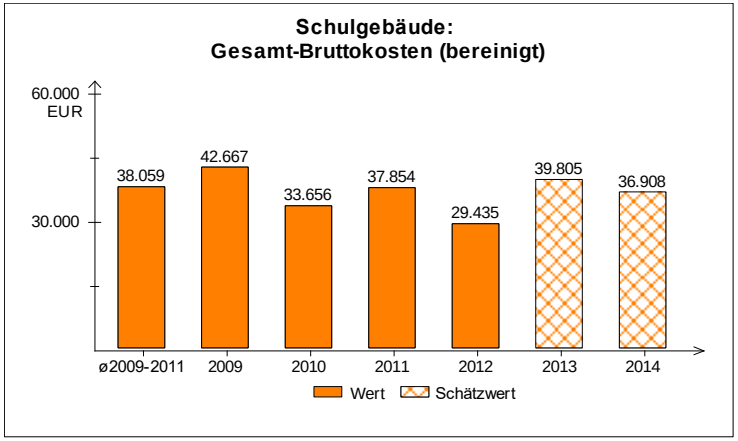
Detailed Yearly Report (excerpt)

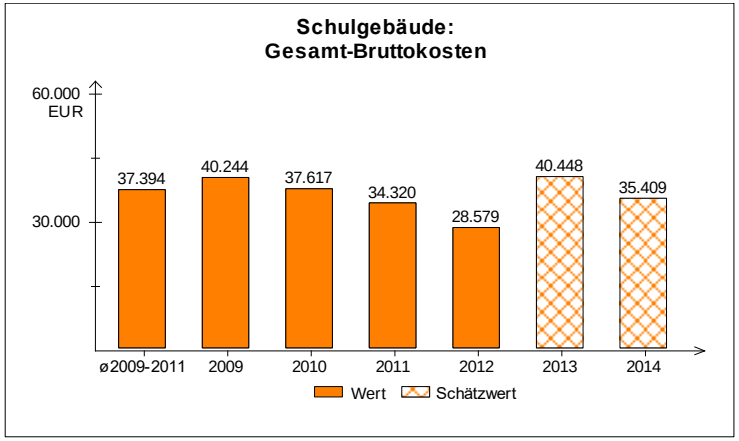
costs

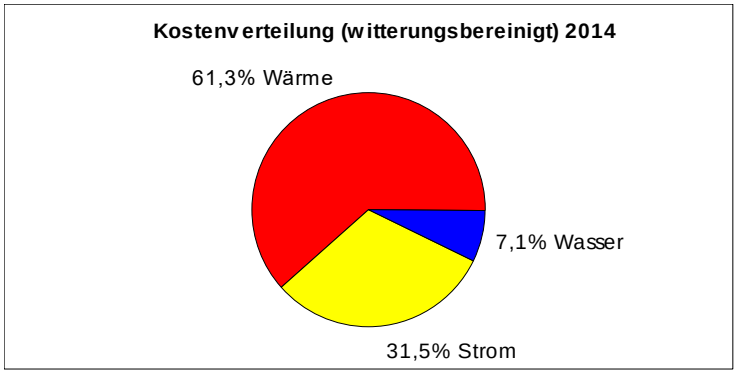


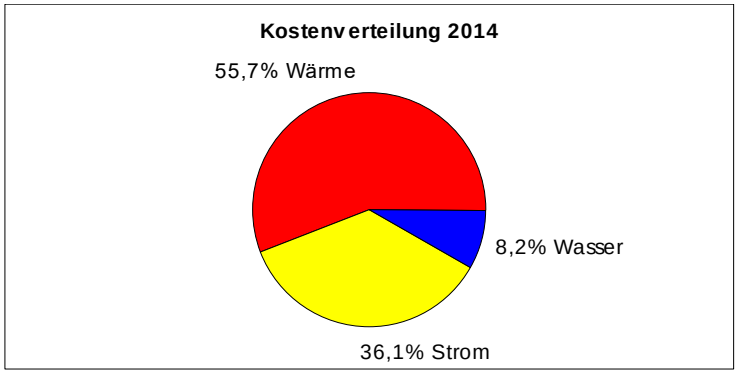






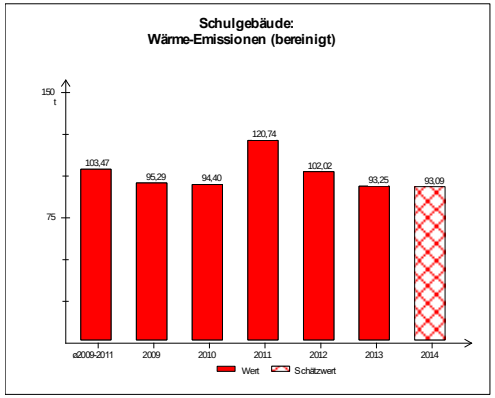


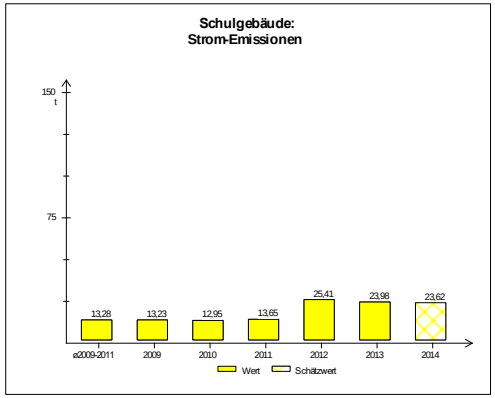


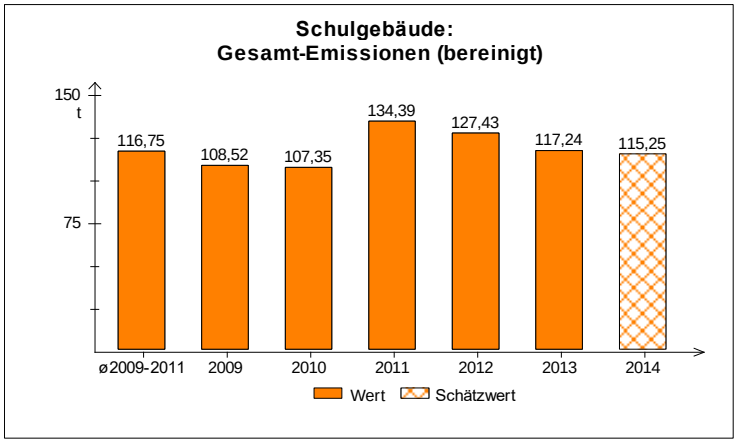


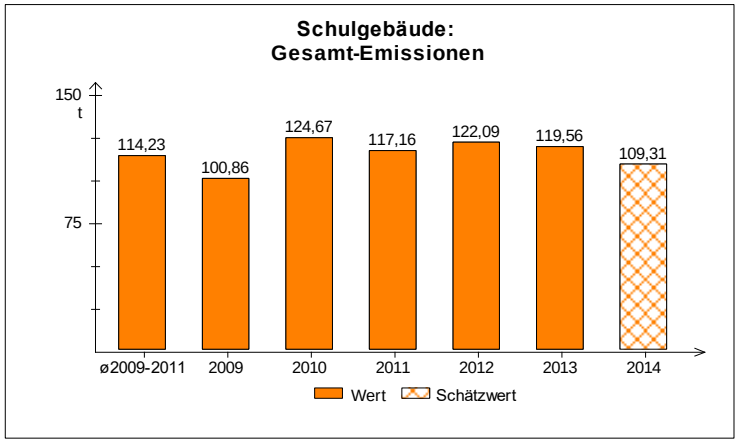
Detailed Yearly Report (excerpt)

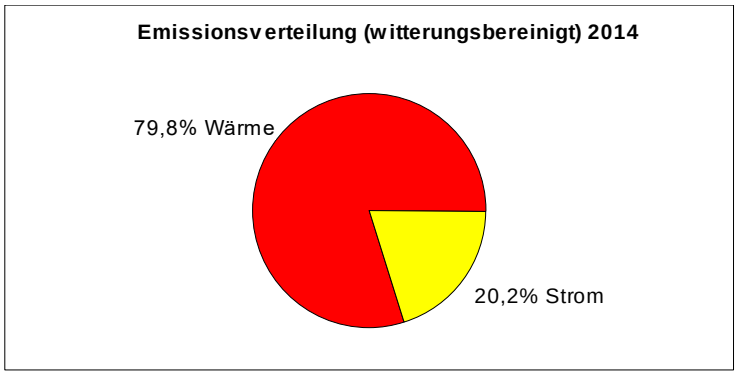
emissions

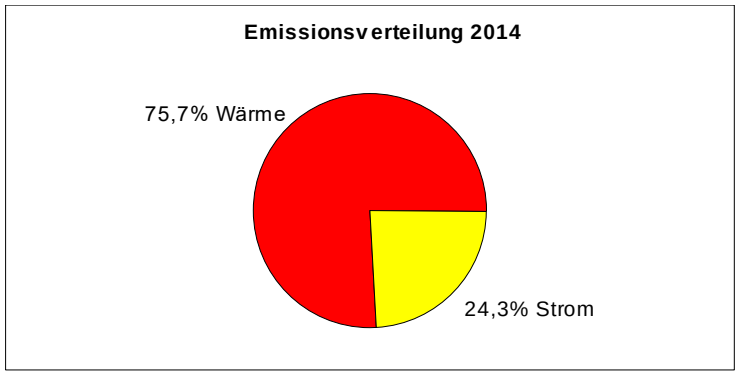












Detailed Yearly Report (excerpt)

summary of building data (building profile)

Rathaus

Nutzung: Büroräume, Bauhof, Jugendraum

Baujahr(e)	1979	
beheizte Fläche	1.325	m²
Hüllfläche	1.909	m²
Umbautes Volumen	4.895	m³
Kompaktheit	0,4	m²/m³

VERBRAUCHSDATEN / GEBÄUDEKENNWERTE 2012-2015

Wärme*	91	MWh/a	69	kWh/(m²a)
Wasser	166	m³/a	0,1	m³/(m²a)
Strom	16	MWh/a	12	kWh/(m²a)

*brennwertbezogen

BEWERTUNG DES GEBÄUDES

Wärmeverbrauchskosten	5,9	€/(m²a)	niedrig – hoch
Wasserverbrauchskosten	0,9	€/(m²a)	niedrig – hoch
Stromverbrauchskosten	2,7	€/(m²a)	niedrig – hoch
Energ. Investitionsbedarf	245	€/m²	niedrig – hoch
Pro oder Contra Sanierung ?			pro – contra

Fazit: Einzelmaßnahmen sind zu empfehlen. Sanierung mit Passivhauskomponenten.

WÄRMEKENNWERTE AUS DEN ENERGIEKONZEPTEN

Empfehlung		Endenergiekennwerte MWh/a	Endenergiekennwerte kWh/(m²a)	Einsparg.	Heizlast W/m²	Energetischer Investitionsbedarf 1.000 €	Energetischer Investitionsbedarf €/m²	äquivalenter Energiepreis €/kWh
	Bestand	91	69		51			0,067
	Passivhaus	17	13	81%	41	325	245	0,285
x	- Geschossdecke	84	64	7%	48	19	14	0,043
(x)	- Fenster	88	66	4%	49	15	11	0,048
(x)	- Kellerdecke	85	64	6%	48	18	14	0,054
	- Heizkessel	89	67	2%	51	37	28	0,735

STROMKENNWERTE AUS DEN ENERGIEKONZEPTEN

Empfehlung		Endenergiekennwerte MWh/a	Endenergiekennwerte kWh/(m²a)	Einsparg.	Energetischer Investitionsbedarf 1.000 €	Energetischer Investitionsbedarf €/m²	äquivalenter Energiepreis €/kWh
	Bestand	16	12				0,244 *
x	Bel./Elektro	13	10	20%	23	17	0,122 *

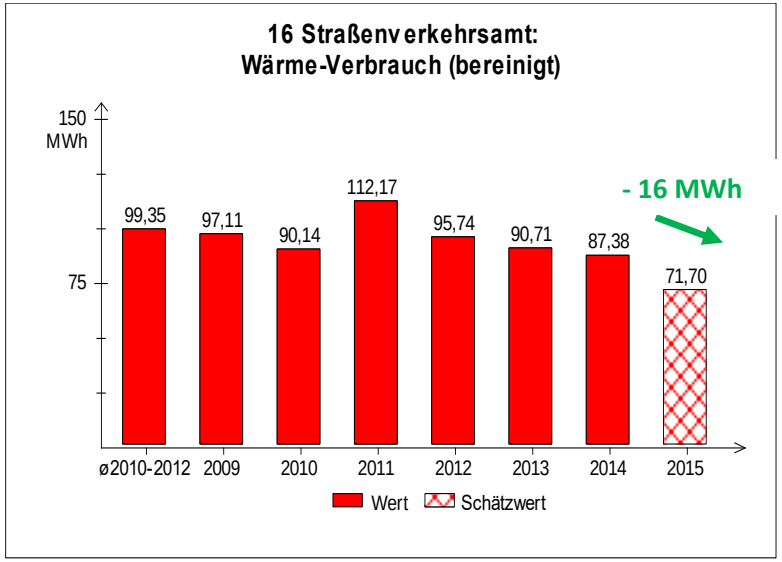
*Eigenstromverbrauch und die Einspeisevergütung der PV-Anlage nicht berücksichtigt

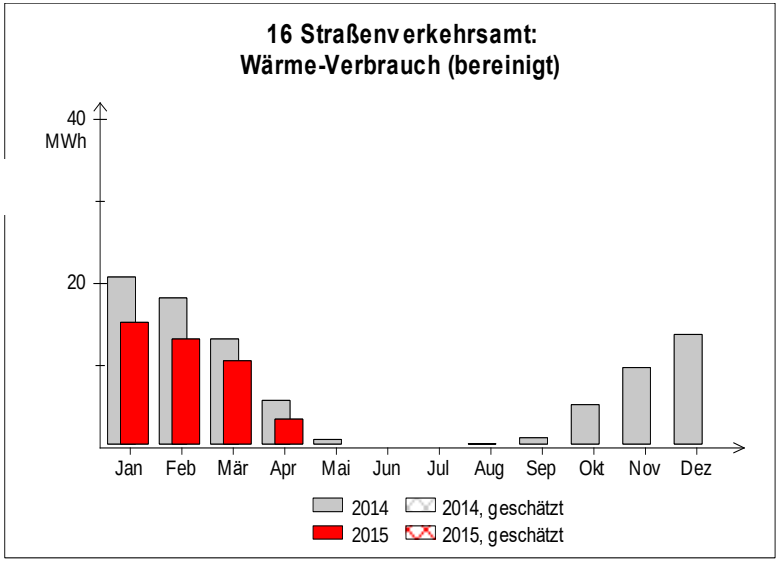
	Istzustand	Instandhaltungsbedarf	Empfohlene Maßnahme
Außenwände	Zweischaliges Mauerwerk (420 mm) mit nachträglicher Dämmung (ca. 100 mm). U=0,23 W/m²K	-	keine
Fenster	Überwiegend bereits 2-Scheiben-Wärmeschutzverglasung mit Kunststoffrahmen (1998) verbaut. Im Treppenhaus Glasbausteine. In der Fahrzeughalle 2-Scheiben-Isolierverglasung mit Aluminiumrahmen.	hoch	Austausch der Glasbausteine und der 2-Scheiben-Isolierverglasung durch 3-Scheiben-Wärmeschutzverglasung.
Außentüren	Bereits 2-Scheiben-Wärmeschutzverglasung mit Aluminium/Stahlrahmen. Kunststofftür im Bauhof. In der Fahrzeughalle Sektionaltore aus Holz mit Einscheibenverglasung.	hoch	Austausch der Holztore (Einscheibenverglasung) durch gut gedämmt Tore mit Wärmeschutzverglasung.
Oberer Gebäudeabschluss	Ursprüngliches Flachdach mit nachträglichem Satteldach-Aufbau. Überwiegend mit Dämmflocken (ca. 160 mm) gedämmt, etwa 30 % ohne Dämmung. Dachschrägen im Archiv (Dachraum) mit Zwischensparrendämmung.	hoch	Das Dach sollte zeitnah vollständig gedämmt werden. Ein U-Wert von 0,15 W/m²K sollte angestrebt werden.
Unterer Gebäudeabschluss	Stahl-Beton-Platte auf Erdreich. Kellerdecke aus Stahlbeton zu beheizten Kellerräumen.	mittel	Wenn möglich sollte die Kellerdecke in unbeheizten Räumen von unten gedämmt werden. Dämmstoffdicken von 8 bis 12 cm sind zu empfehlen.
Heizungsanlage	Gas-Brennwertkessel von Viessmann Condensola CX065, Baujahr 1998, Leistung 23,7-67,7 kW	hcoh	Einbau von Hocheffizienzpumpen und voreinstellbarer Thermostatventile. Durchführen eines hydraulischen Abgleichs. Mittelfristig sollte ein verbesserter Brennwertkessel

Illustrating Modernization Measures

Road Traffic Department, automn 2014:

- facade insulation
  (14 cm, WLS 035, new U-value: 0,219 W/m²K)
- roof insulation
  (19 cm, WLS 040, new U-value: 0,199 W/m²K)
- new windows
  (Uw-value ≤1,30 W/m²K)

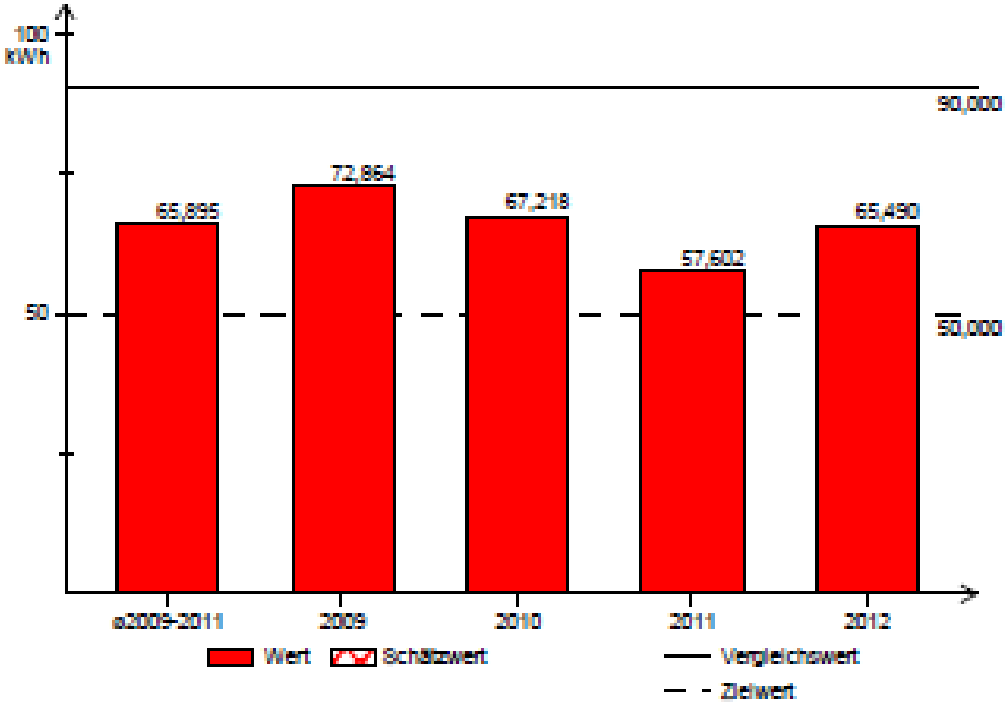




Benchmarking

Example: Town Hall Hessisch Oldendorf

comparative figures and target values from the AGES Study

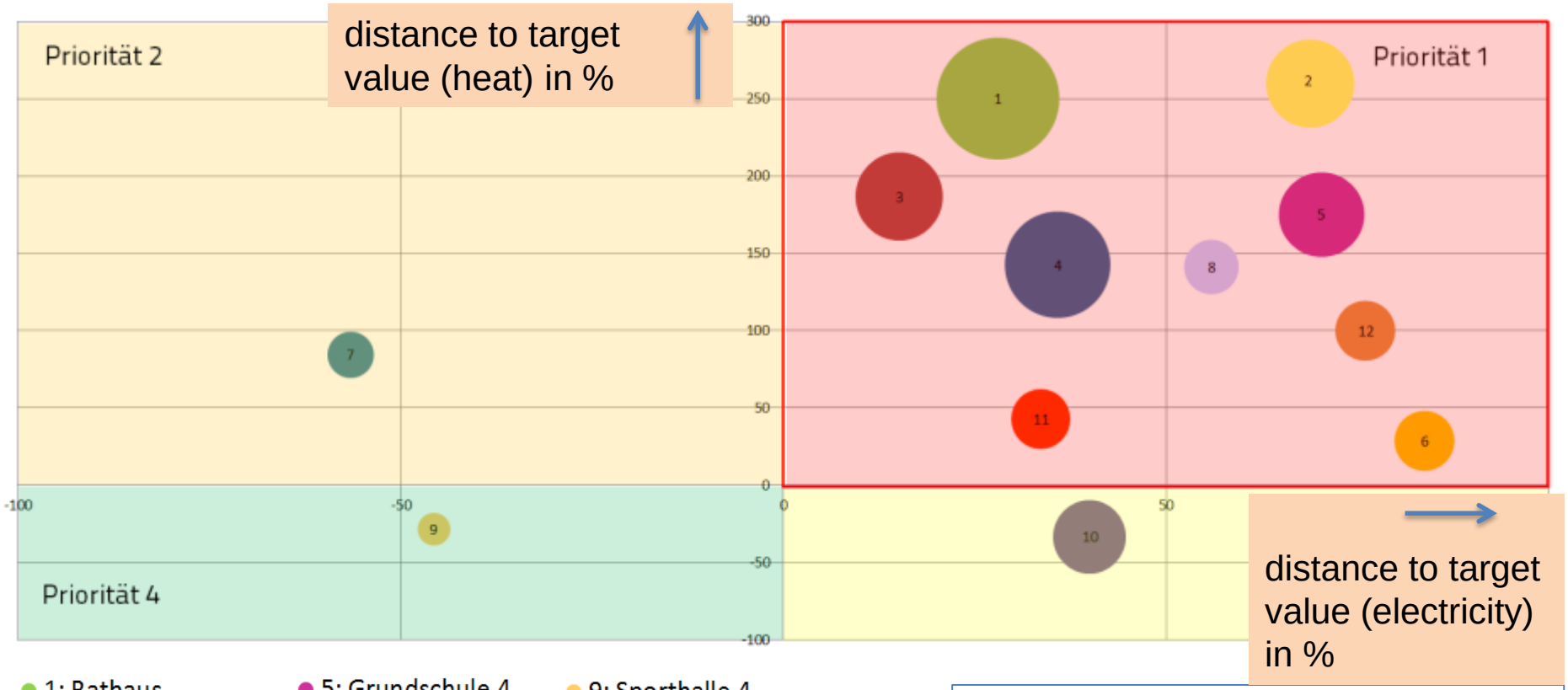


comparative figure (mean value)

target value:
Mean value of the best 25%

Consumption Parameters and Benchmarking

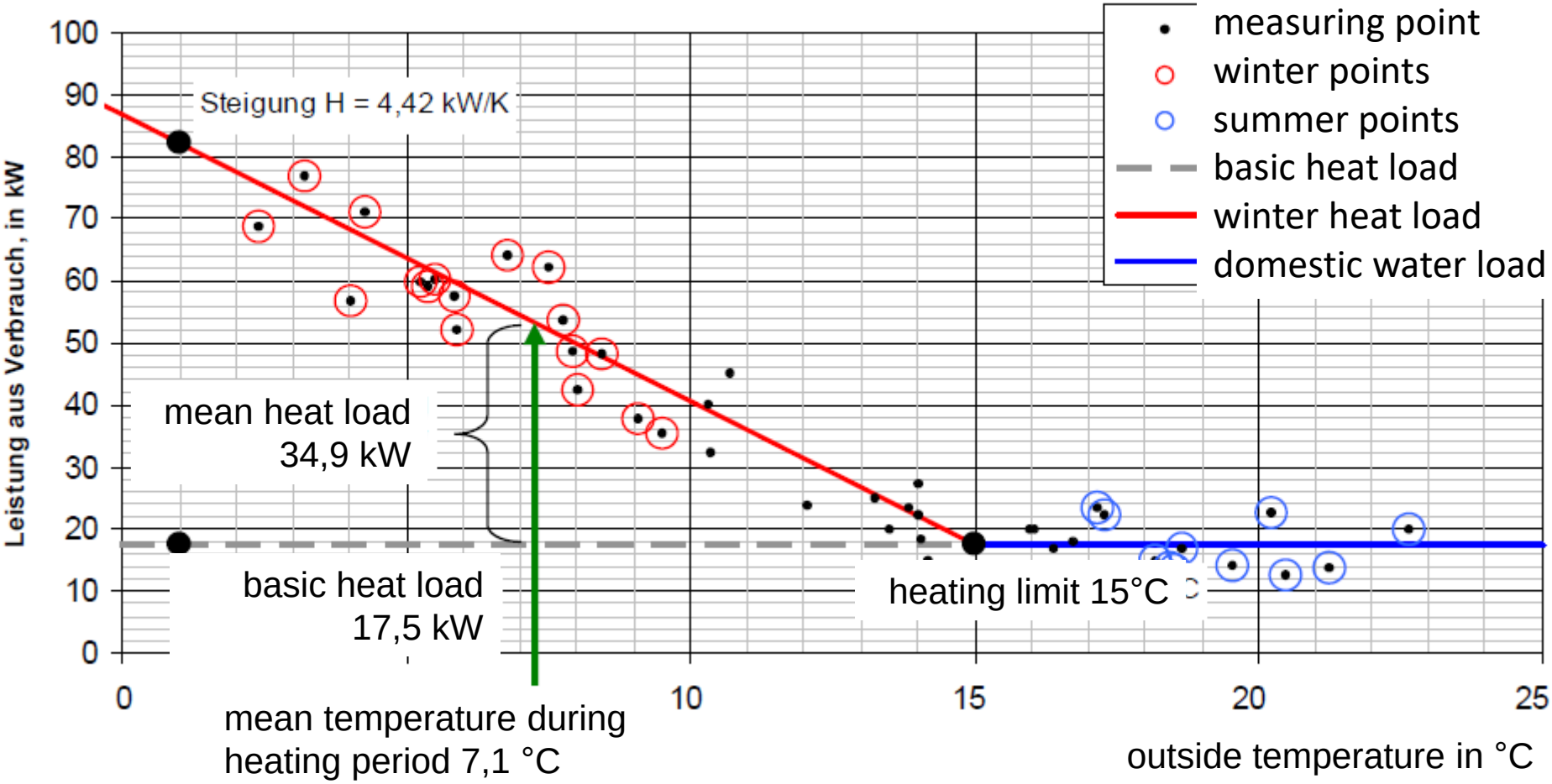
priority list heat and electricity (consumption and costs)



- 1: Rathaus
- 2: Grundschule 1
- 3: Grundschule 2
- 4: Grundschule 3
- 5: Grundschule 4
- 6: Sporthalle 1
- 7: Sporthalle 2
- 8: Sporthalle 3
- 9: Sporthalle 4
- 10: Bauhof und Feuerwehr
- 11: Kindergarten 1
- 12: Kindergarten 2

The size of the circles shows each property´s share in the total energy costs.

Energy Analysis from the Consumption

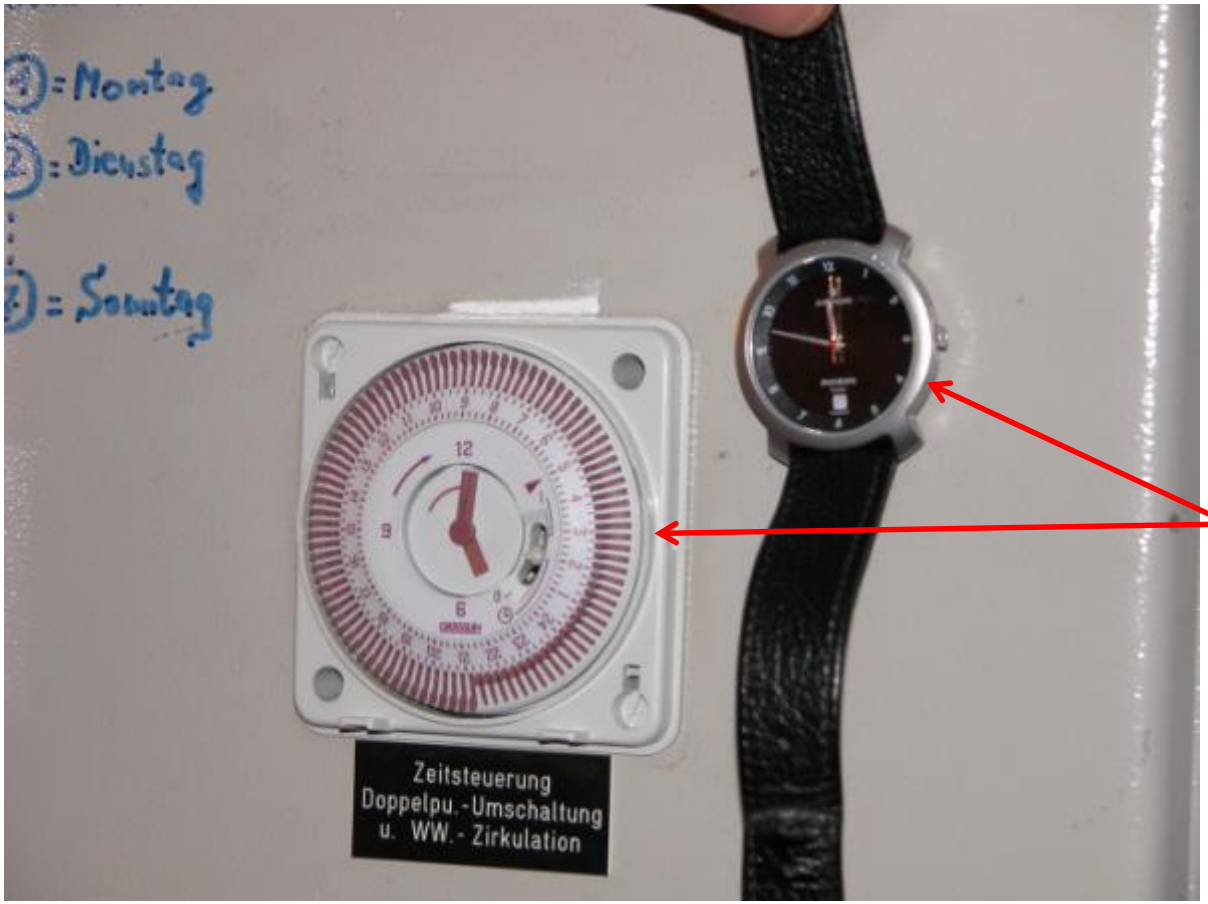


Energy Monitoring is Basis for Optimization

Optimization in the first step by no or low cost measures

- controller adjustment
- setting of timers
- adjustment of the running times to the times-of-use
- heating times and heating curves are optimised
- hydraulic balancing

Optimization - Examples



setting of timers

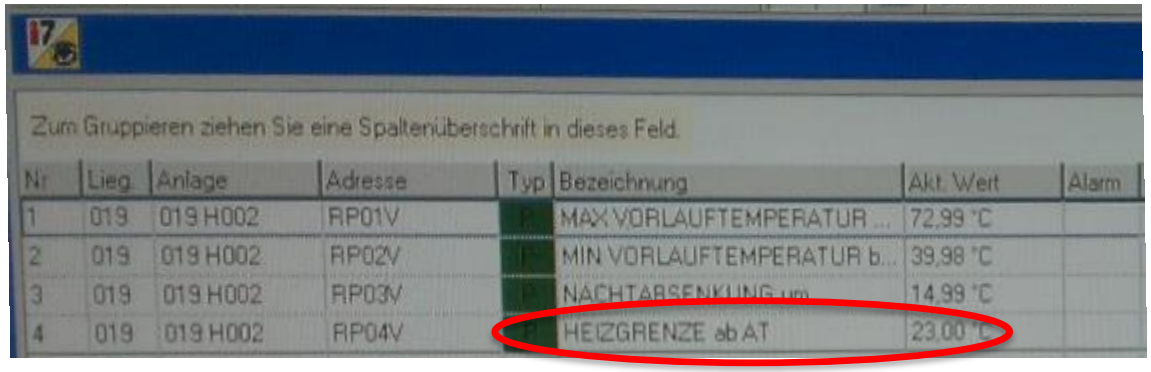
just before 12:00!?

Optimization - Examples

poor adjustment:

heating curve → straight line

Optimization - Examples



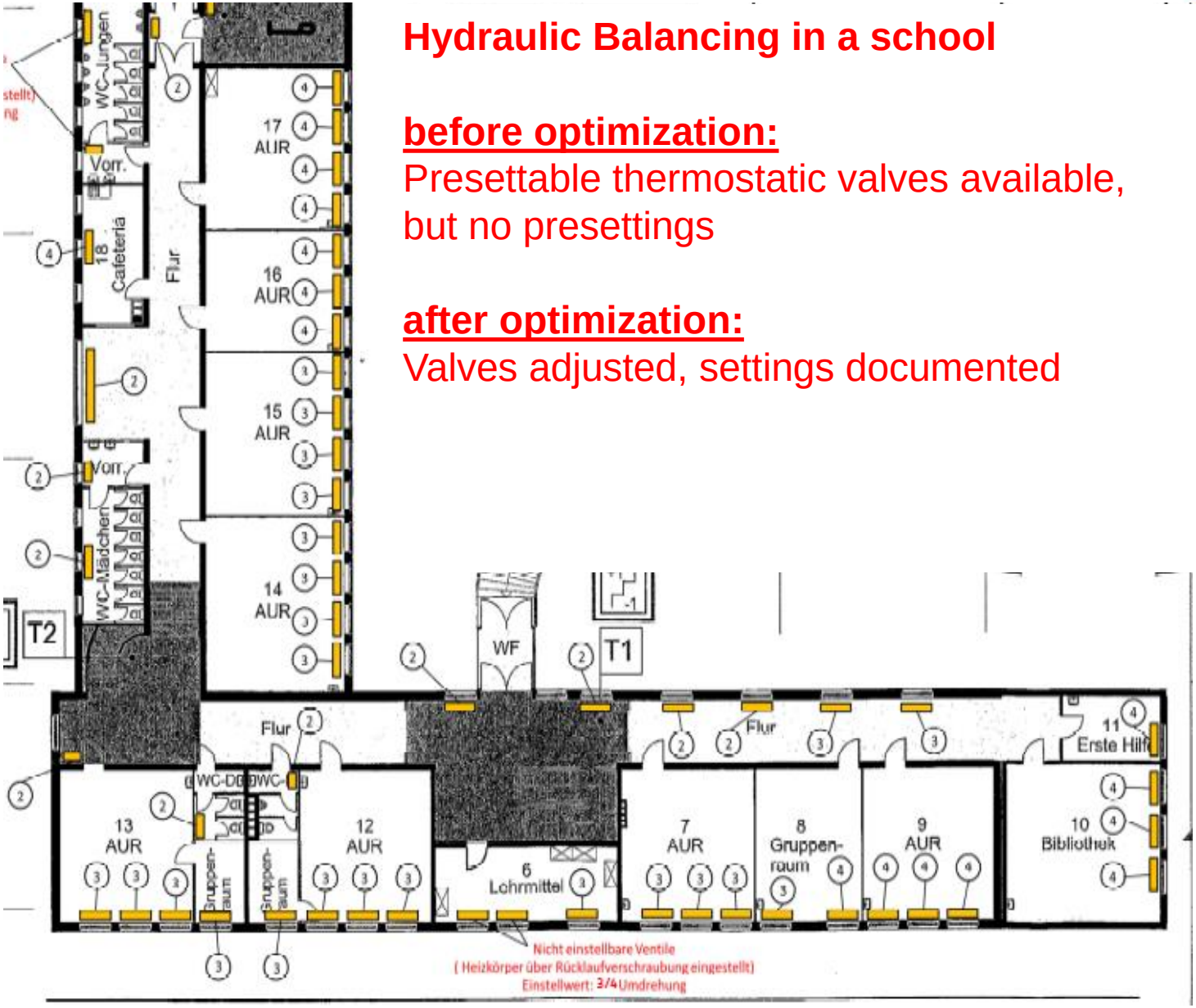
Zum Gruppieren ziehen Sie eine Spaltenüberschrift in dieses Feld.

Nr	Lieg.	Anlage	Adresse	Typ	Bezeichnung	Akt. Wert	Alarm
1	019	019 H002	RP01V		MAX VORLAUFTEMPERATUR ...	72,99 °C	
2	019	019 H002	RP02V		MIN VORLAUFTEMPERATUR b...	39,98 °C	
3	019	019 H002	RP03V		NACHTABSENKUNG um	14,99 °C	
4	019	019 H002	RP04V		HEIZGRENZE ab AT	23,00 °C	

typical heat limit temperatures:

- 15°C existing buildings before 1998
- 12°C buildings after 1998
- 10°C low energy buildings or passivhaus

Optimization - Examples

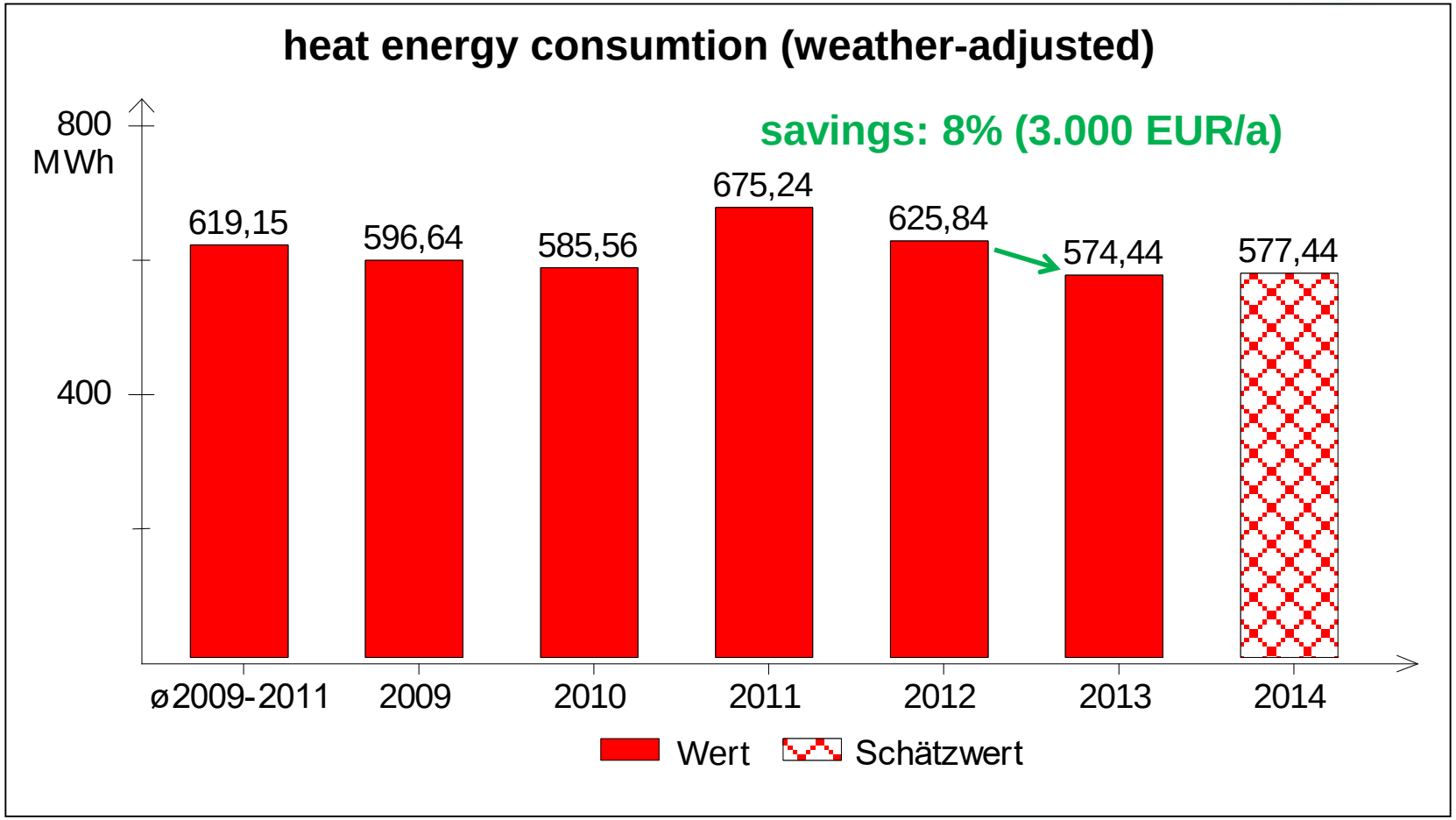


Hydraulic Balancing in a school

before optimization:
Presettable thermostatic valves available, but no presettings

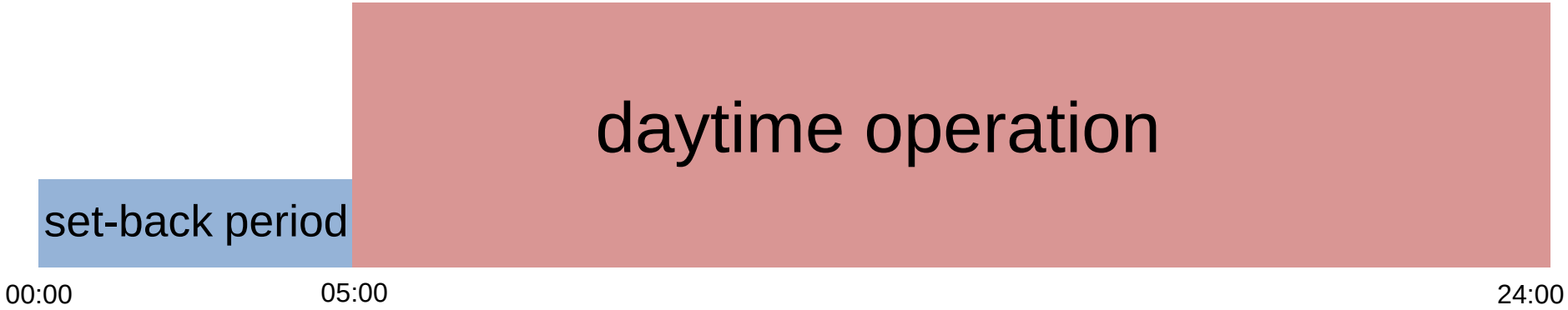
after optimization:
Valves adjusted, settings documented

Optimization - Examples

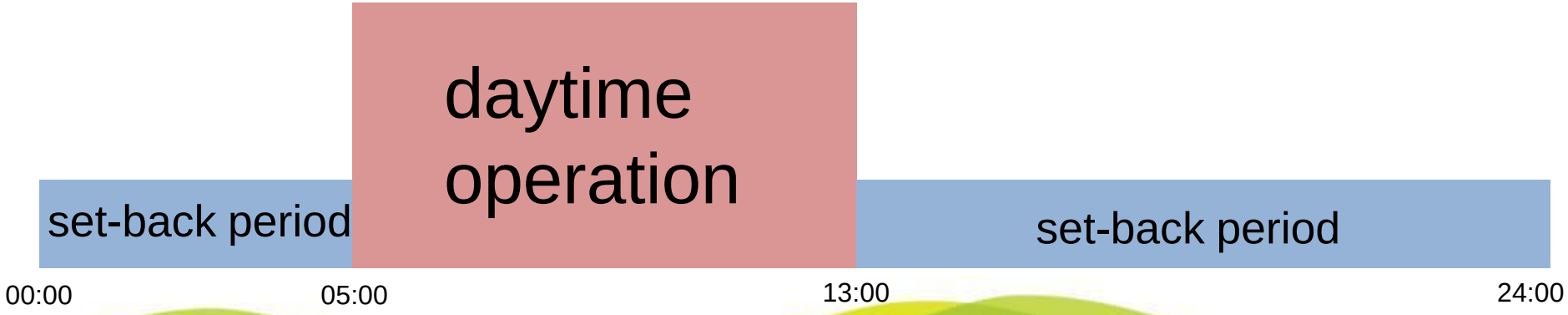


Optimization - Examples

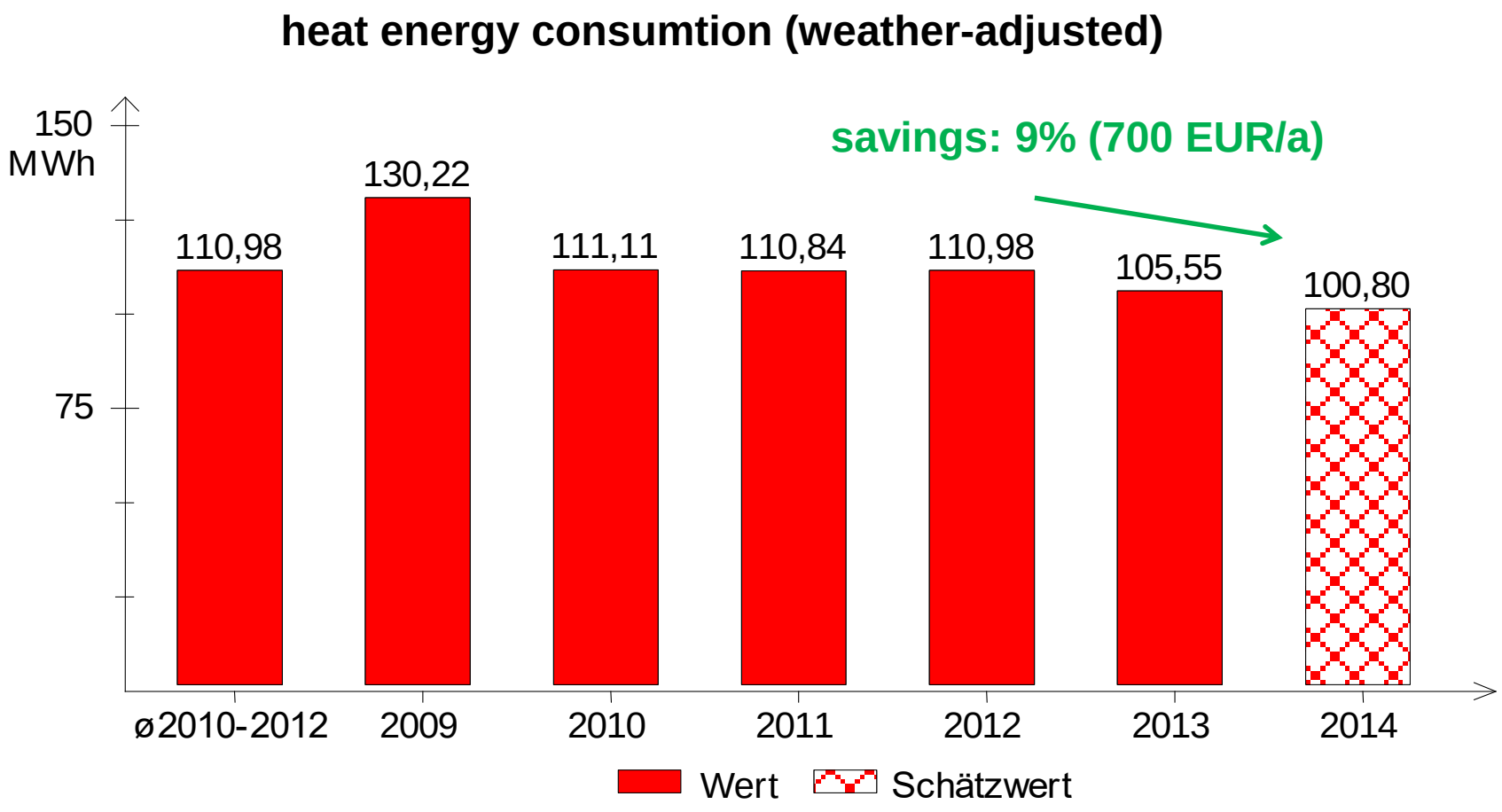
before optimization:



after optimization:

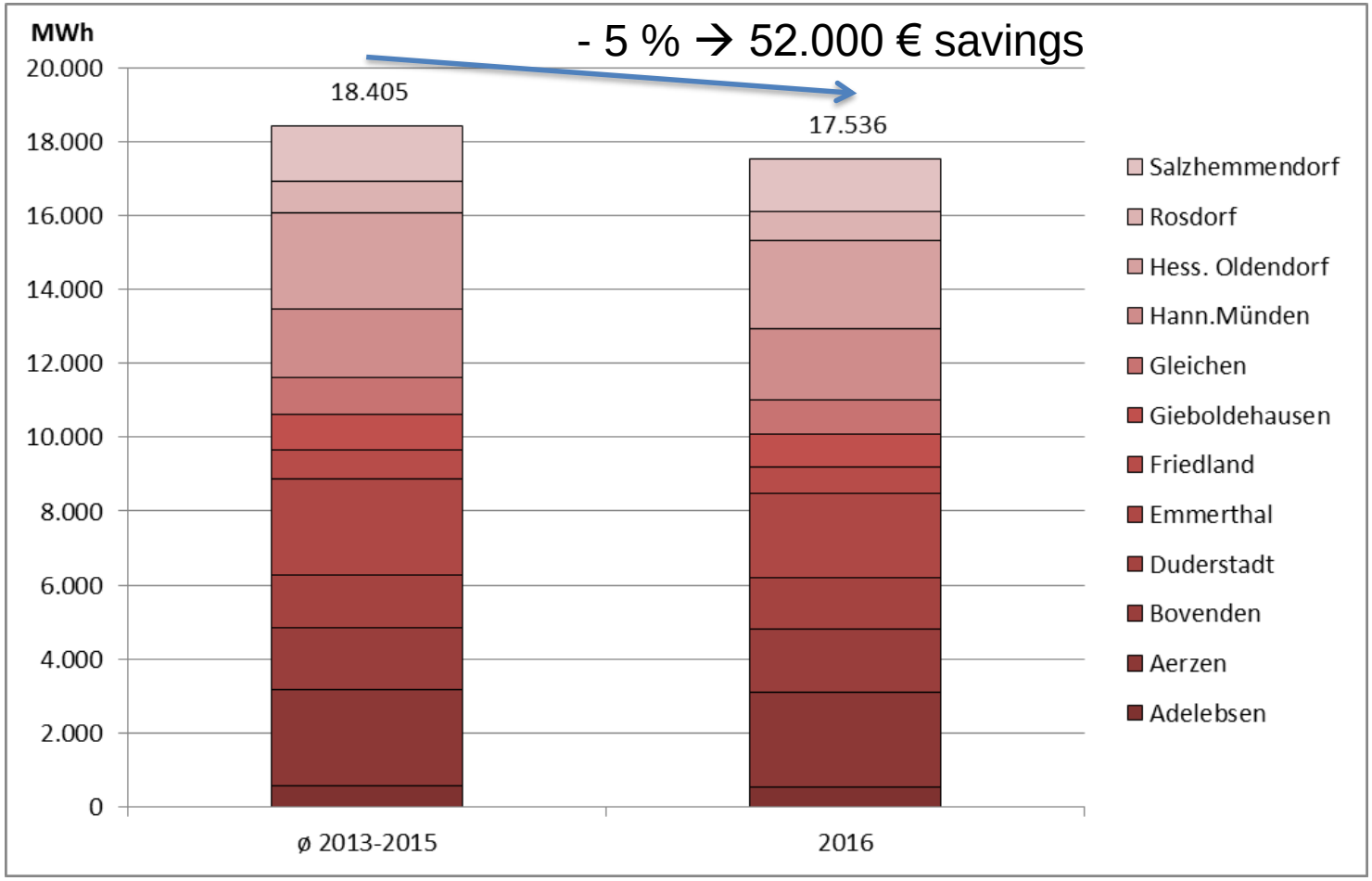


Optimization - Examples



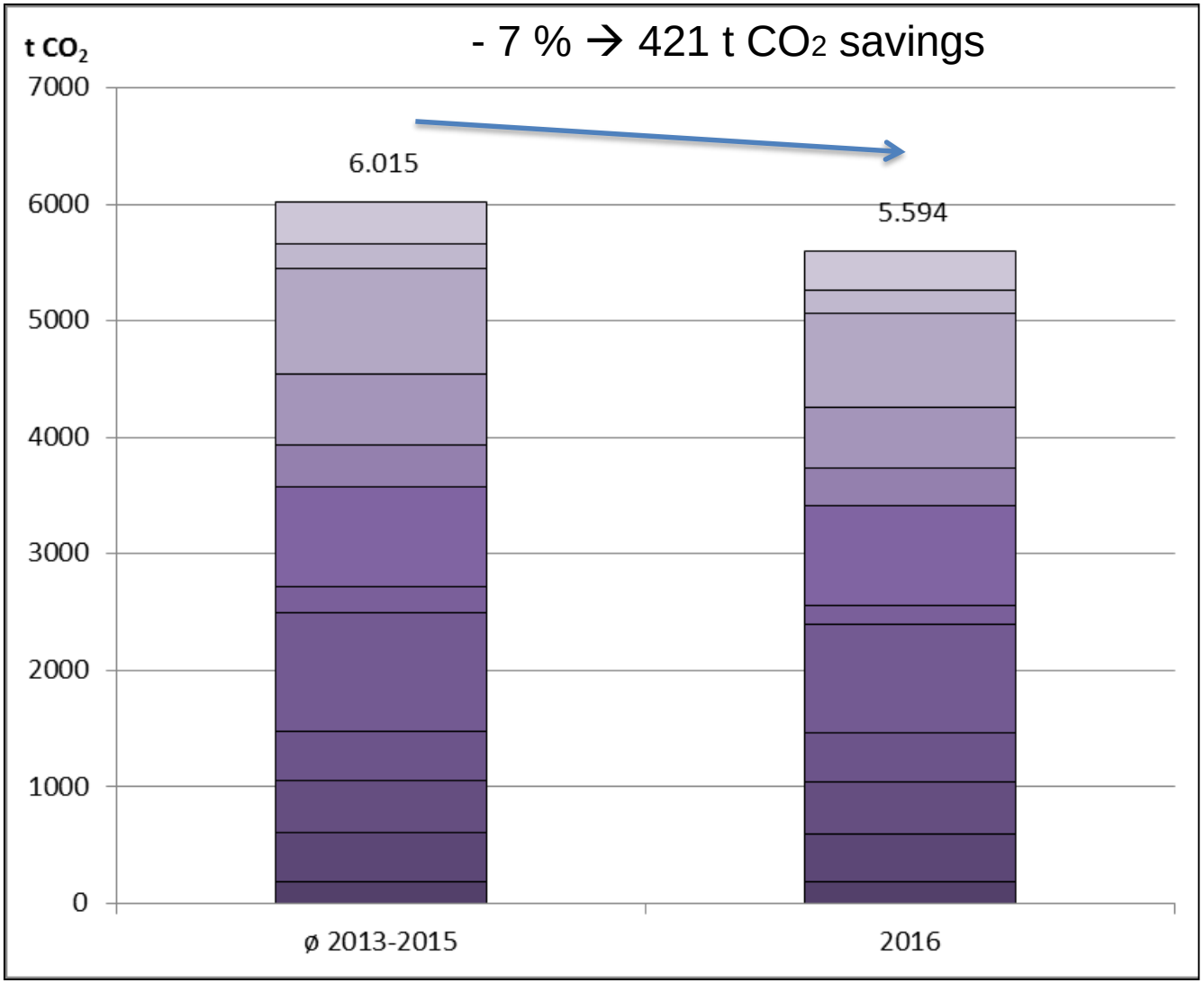
> 5 % Energy Savings through Monitoring

<u>BAFA-Network with 12 municipalities</u> (10 buildings each)



CO_2-savings through Monitoring

Emissions



Summary and Conclusion

- monitoring of energy and CO_2-savings is the basis for a **systemical municipal energy management**
- against the background of amibitionized climate protection goals municipal energy management has to **become a duty assignment for municipalities**
- energy reports are an important tool to **summarize energy and CO_2-savings** to decision makers **in a vivid way**
- the monitoring of energy savings helps to **evaluate the success of different energy saving measures** and to learn for the future

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