

The background image is a composite. The left side shows a close-up of solar panels installed on a flat roof under a blue sky with scattered clouds. The right side shows a wide-angle view of a modern university building with a prominent glass dome, also featuring solar panels on its roof. The text 'Sustainability at Universities' is overlaid in the center in a large, bold, blue font.

Sustainability at Universities

Introduction

Universities and Sustainability

- **Research:** Developing knowledge of technological and social transformation towards a sustainable future
 - **Teaching:** Developing the requisite interdisciplinary and transdisciplinary skills for the current and future decision makers
 - **Outreach:** Fostering collaborations with societal stakeholders in order to promote the discourse of sustainability
 - **Campus:** Universities as infrastructural and social testbed for sustainable solutions (campus as a living lab, universities as sustainability pioneers)
- ⇒ **Whole institution approach:** Going beyond the usual segmentation of a higher education institution

Sustainability at Universities

Panel 1: Energy Efficiency as a Key Factor of Sustainable Campus Management (Chair: André Niemann)

- Key Instruments for Improving Energy Efficiency at Freie Universität Berlin (Andreas Wanke & Melanie Thie)
- Retrofit to Reach Plus Energy Standard in an Office Building at TU Vienna (Reinhard Haas)
- Experiences from De Montfort University, Leicester (Paul Fleming)

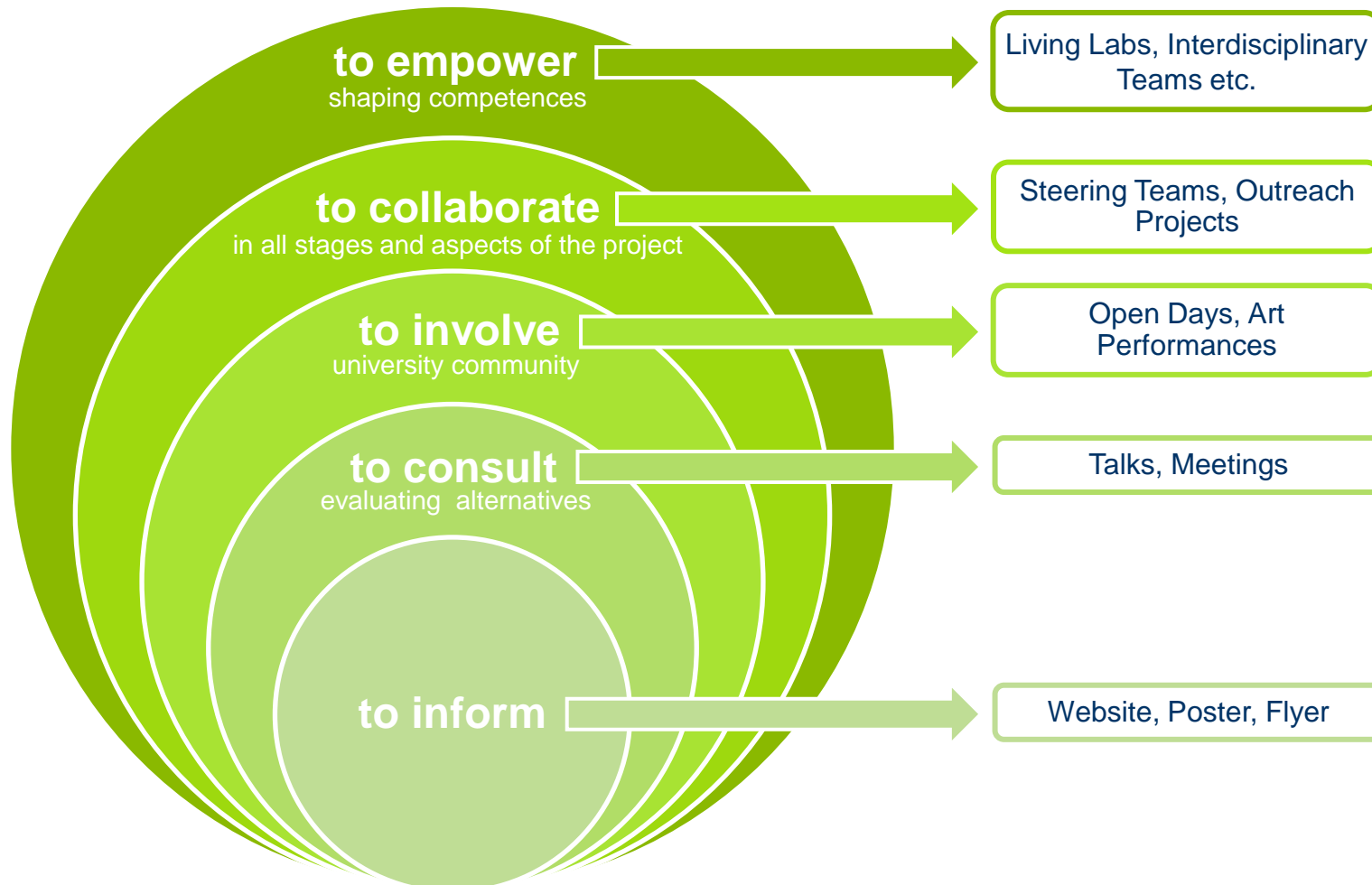
Panel 2: Universities as Incubators for Sustainability

- Sustainable University of Duisburg-Essen – Pathways towards Sustainable Development with a special focus on Energy Efficiency as a Key Factor (André Niemann)
- The Potential of International Networks to Trigger Innovation: The “University Alliance for Sustainability” (Katrin Risch)

Key questions

- What was the most important successful element of your improvement? What hurdles did you have to overcome?
- Who or what internal and external factors triggered the process? Did these persons or factors change over time?
- How do you evaluate the significance of the technical, economic, management related and social factors? Did they change over time?
- Did the campus community (faculty, administration staff and students) play a role? Please outline the role of administration.
- What role did participation play within your process? Did your sustainability strategy work more top down or bottom up? On reflection, do you see more necessities and opportunities for participation? What kind of participation?

Participatory Approaches



Key Statement

In most cases campus related sustainability processes focus on infrastructural improvements, based on technical and economic studies and arguments. The success of the corresponding measures frequently depends on aspects of organizational development, governance and participation. Taking the significance of these factors into account, comprehensive knowledge about their mechanisms and changeability is often lacking. Living lab projects, which see universities as testbeds for sustainability solutions, could be an instrument to close this gap.



Key Instruments for Improving Energy Efficiency at Freie Universität Berlin

Panel: Sustainability at Universities

Agenda

Current Situation

- Energy Balances

Key Instruments

- In Chronological Order

Lessons Learned

- Governance and Participation Matter





CURRENT SITUATION

33,000 students
(incl. 4,300 PhD students)

founded in 1948















**5,100 employees (4,230 FTE),
incl. 349 professors**
(plus 110 junior professors)

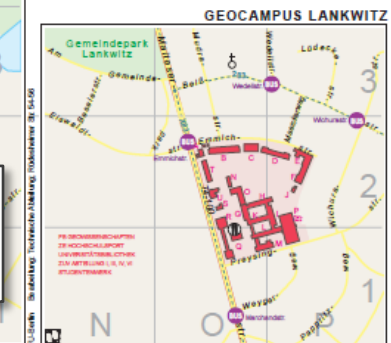
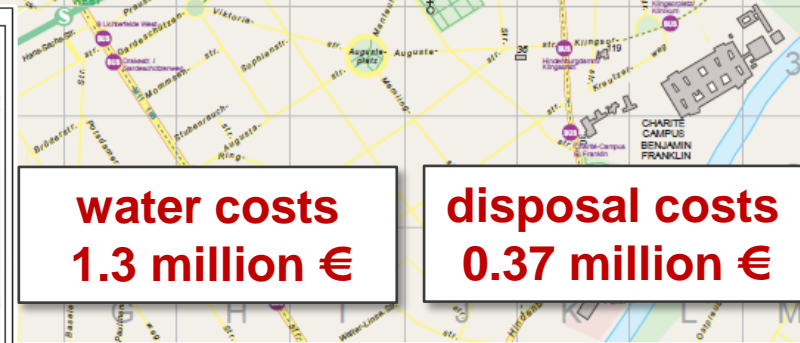
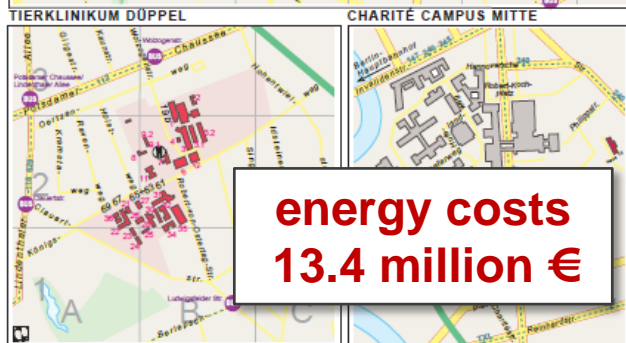
**ca. 200 buildings
with 530,000 m²**

government grant: 298.5 million €
third-party funds: 124 million €

HOCHSCHULSTANDORTE IN
-DAHLEM UND STEGLITZ
-DÜPPEL
-LANKWITZ
-MITTE

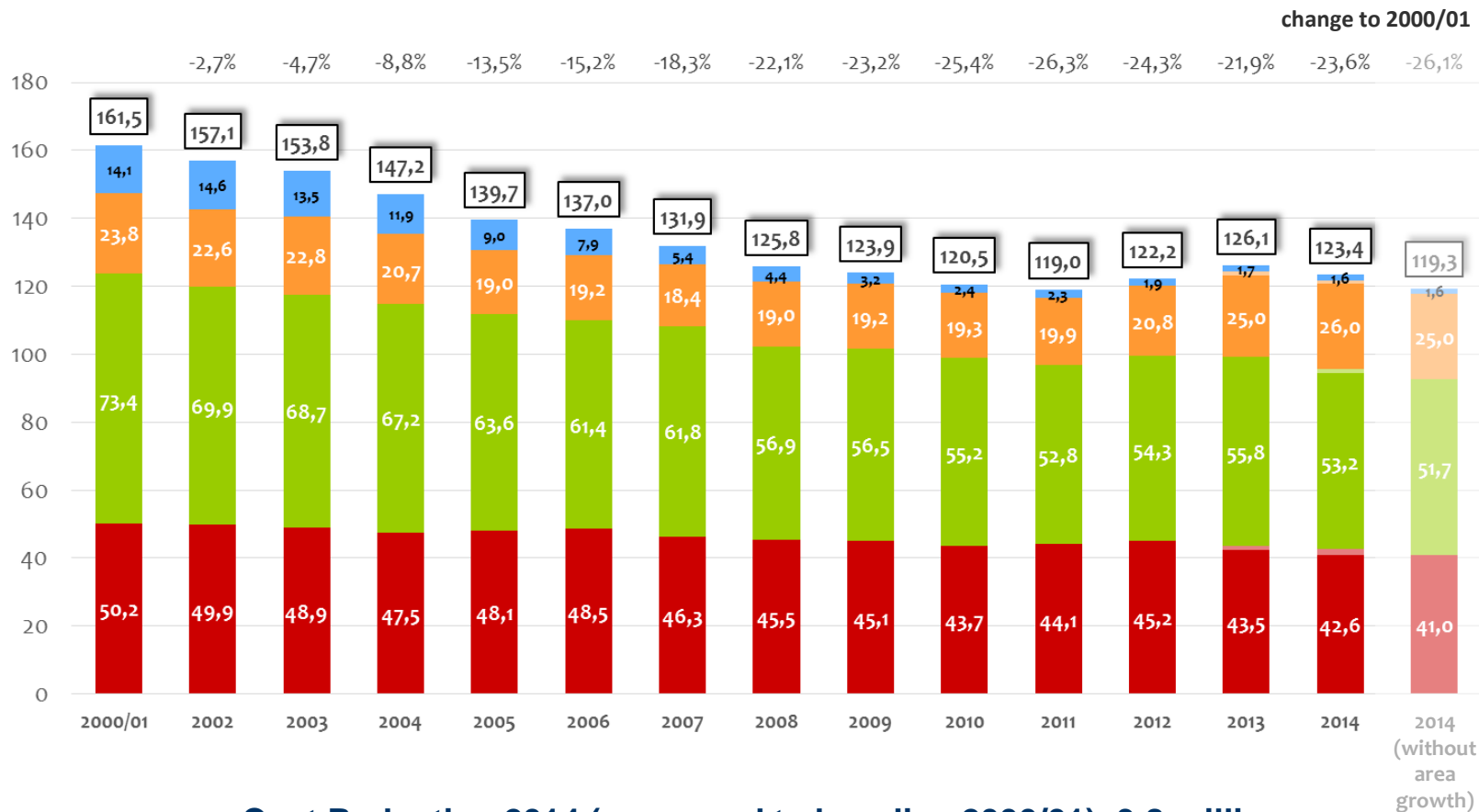
Stand 18.08.2014

-  Gebäude der FU mit Grundstücksfläche und Hausnummer
-  GEOFISIK Einrichtung der FU (Auswahl)
-  Mensa
-  Gebäude mit teilw. FU-Nutzung
-  Übrige bebaute Fläche
-  Grünfläche
-  Gewässerfläche
-  **Hauptallee:** Wichtige Hauptstraße
-  **Straße:** Hauptstraße
-  **Gasse:** Nebenstraße
-  Buslinie mit Haltestelle
-  S-Bahn Linie mit Bahnhof
-  U-Bahn Linie mit Bahnhof
-  Bushaltestelle



Energy Procurement 2000 – 2014

in million kWh, heating data weather adjusted



-23.6 %
(-26.1%)

-88.8 %
(-88.8%)
heating
oil

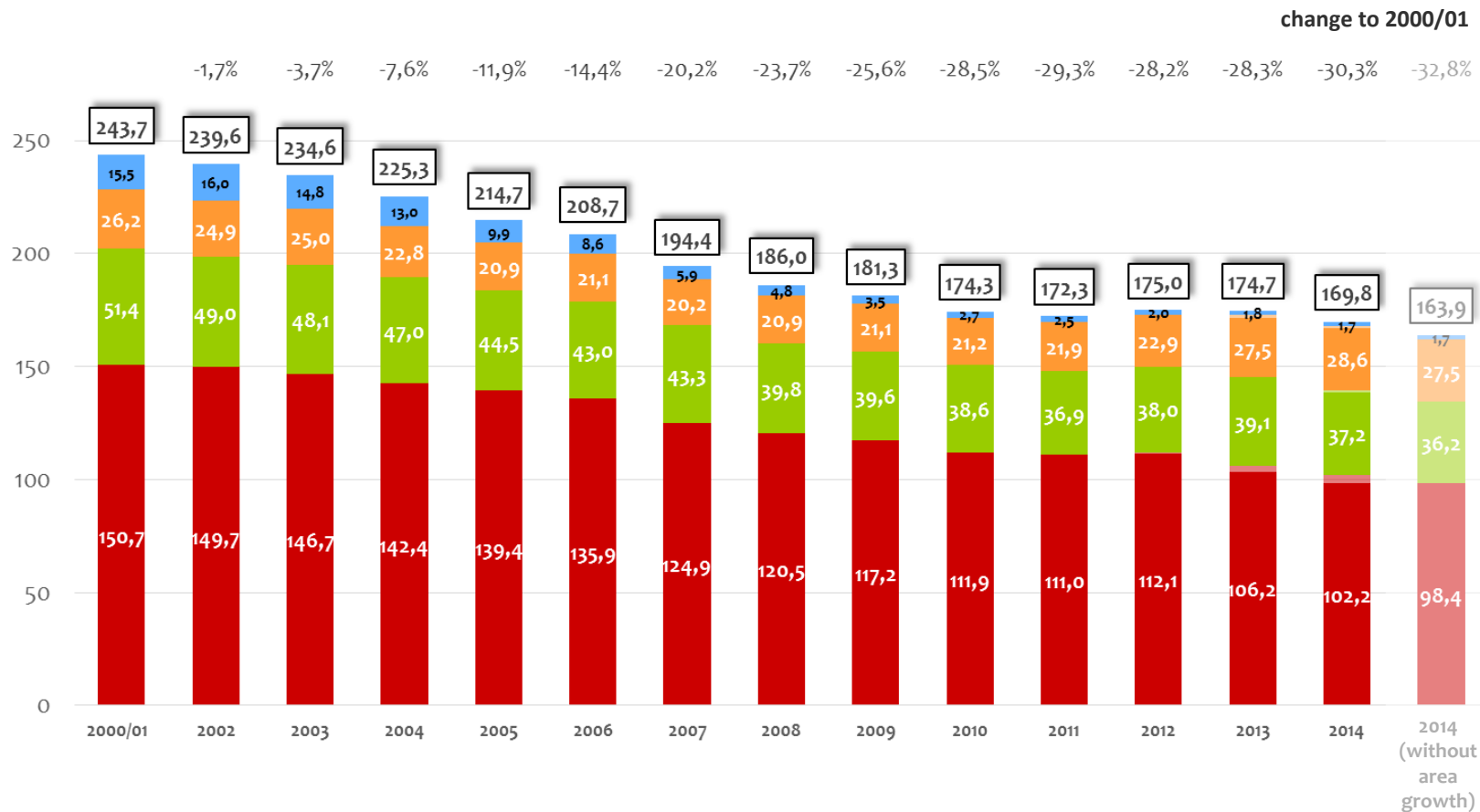
+9.5 %
(+5,6%)
natural
gas

-27.5 %
(-29,5%)
district
heating

-15.2 %
(-18,%)
power

Primary Energy Input 2000 – 2014

in million kWh, heating data weather adjusted, PE-factors with GEMIS



-30.3 %
(-32.8%)

-88.8 %
(-88.8%)
heating oil

+9.5 %
(+5.3%)
natural Gas

-27.5 %
(-29.5%)
district heating

-32.2 %
(-34.7%)
power



Structural Barriers in the Area of Energy Efficiency

Interdependences between technical, organizational & behaviour focused measures

Small-scale structure of energy efficient measures (technical & organizational)

Technological heterogeneity

Few visualisation options

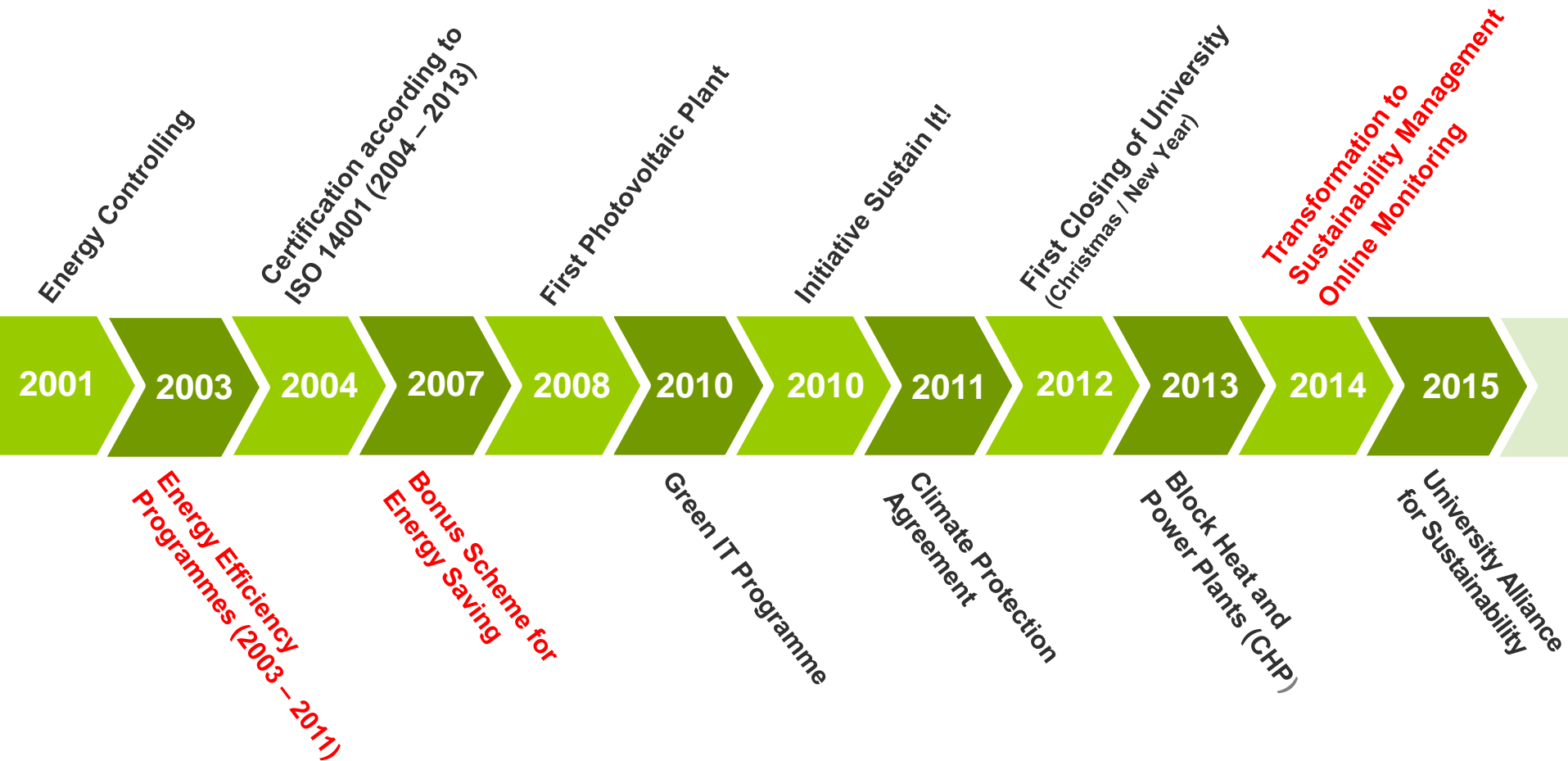
Organizational segmentation of higher education organizations

Considerable communication expenditure



KEY INSTRUMENTS

Chronology



Key Instrument 2: Annual Energy Efficiency Programmes for Buildings



Modernisation of heating systems, ventilation plants and regulating technologies (2003-2011)

Elimination of weak points in the building construction (insulation of roofs & top storey ceiling)

High economic feasibility with payback periods < 5 years

Heating savings between 15 % and 50 %, averaged at 33 %

2003

Key figures of selected modernization projects

Facility

Used by

Space in m²

Measures

Year

Funds

Heating Saving
Power Saving

ROI (Energy Prices 2005)

ROI (Energy Prices 2008)

ROI (Energy Prices 2010)

Silberlaube

Education and Psychology /
PC-Pools

31,708 m²

Modernization of heating
plant, optimization of
ventilation regulation and
lighting

2003

161,972 €

1,230 MWh/a
90 MWh/a

2.2 years

1.8 years

1.6 years

Düppel

Veterinary Medicine

33,989 m²
(24 buildings)

Modernisation of Heating
centre (4,2 MW)
and heating plants in 24
buildings

2004

803,578 €

3,390 MWh/a
300 MWh/a

4.4 years

3.2 years

3.6 years

Innestr. 22

Political and
Social Sciences

3,990 m²

Modernization of heating
plant, insulation of upper
storey ceiling

2003

65,849 €

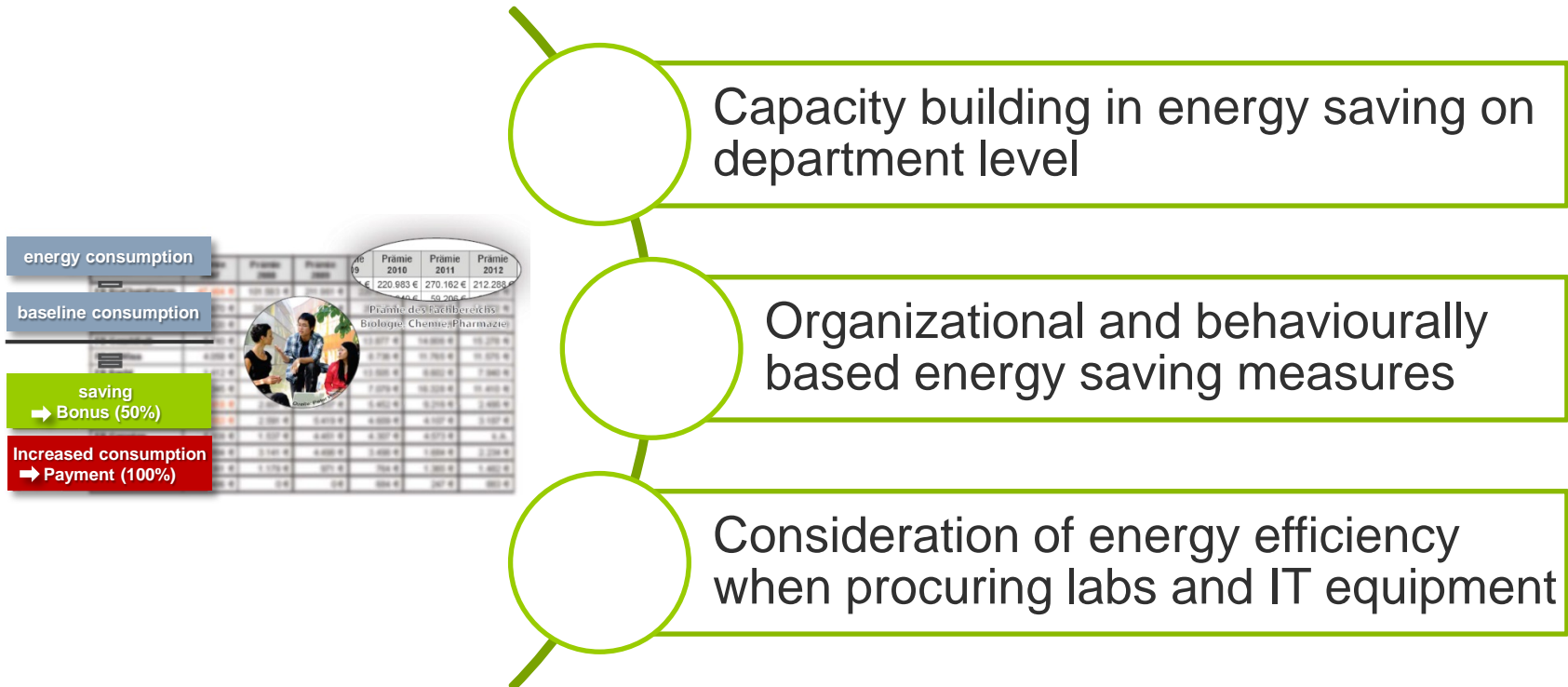
188 MWh/a
2 MWh/a

6.6 years

5.3 years

4.7 years

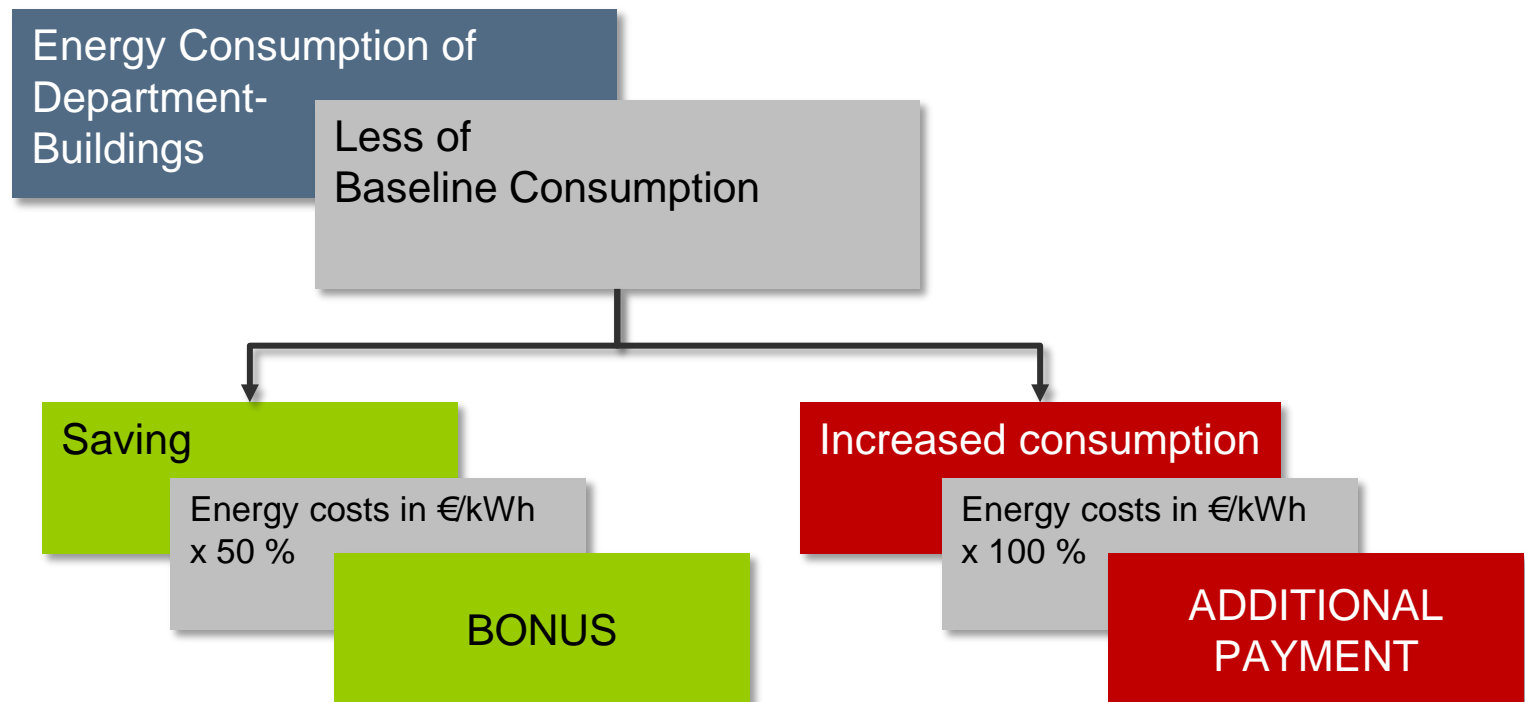
Key Instrument 4: Bonus Scheme for Energy Saving



2007

Bonus Scheme

Principles



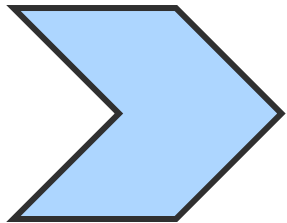
Bonus Scheme

Results 2007 - 2012

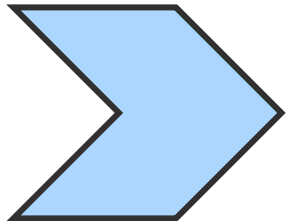
Department	Bonus 2007	Bonus 2008	Bonus 2009	Bonus 2010	Bonus 2011	Bonus 2012 (Baseline: -2%)	Bonus 2013*) (Baseline: -4%)
Biology, Chemistry, Pharmacy	-47,464 €	101,583 €	211,961 €	220.983 €	270,162 €	212,288 €	176,876 €
Physics	5,670 €	20,199 €	13,333 €	25.049 €	59,206 €	31,602 €	44,481 €
Political and Social Sciences	13,620 €	8,837 €	12,191 €	9.945 €	4,461 €	4,882 €	6,270 €
History / Cultural Studies	5,740 €	8,700 €	12,427 €	13.877 €	14,806 €	15,278 €	6,468 €
Business & Economics	4,058 €	7,070 €	8,144 €	8,736 €	11,765 €	11,575 €	9,304 €
Laws	1,412 €	6,597 €	14.138 €	13,505 €	6,602 €	7,940 €	7,115 €
Philosophy & Humanisties	4,345 €	5,522 €	4.513 €	7,079 €	16,328 €	11,410 €	6,580 €
Education & Psychology	-5,918 €	2,601 €	5.837 €	5,452 €	8,218 €	2,495 €	1,141 €
Mathematics & Computer Sciences	-2,553 €	2,591 €	5.419 €	4,609 €	4,107 €	3,187 €	5,486 €
Earth Sciences	5,909 €	1,537 €	4.451 €	4,307 €	4,573 €	536 €	k.A.
ZI East European Studies	1,994 €	3,141 €	4.498 €	3,498 €	1,684 €	2,234 €	2,313 €
ZI Latin American Studies	361 €	1,179 €	971 €	764 €	1,365 €	1,482 €	738 €
ZI John F.- Kennedy Institute	486 €	0 €	0 €	684 €	247 €	883 €	- 629 €

Bonus Scheme

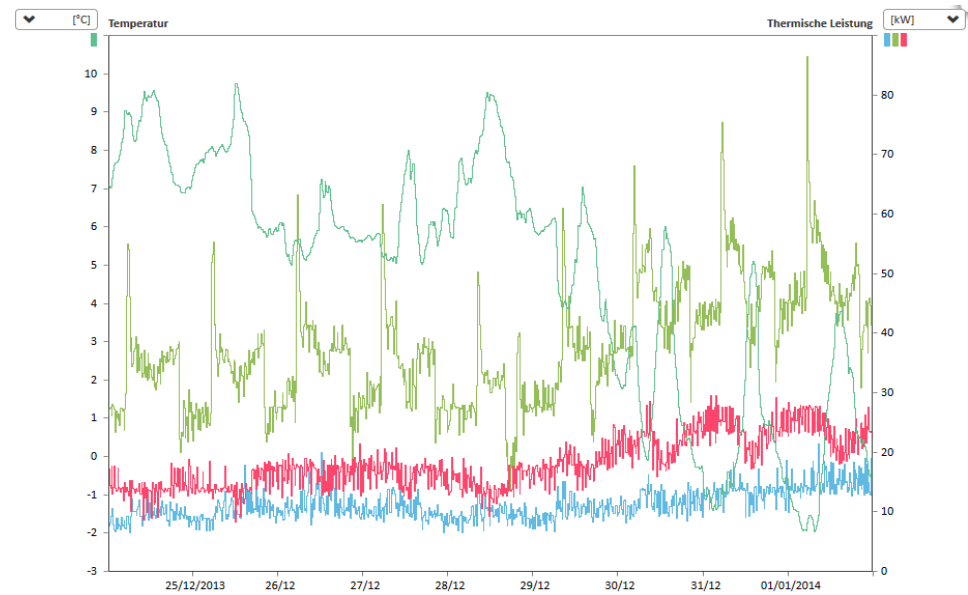
Conclusions



Cut of the baseline by two percent per year in 2012 and 2013 and by three percent in 2014 and 2015



Closing the university at Christmas / New Year for two weeks, implemented since 2012/13

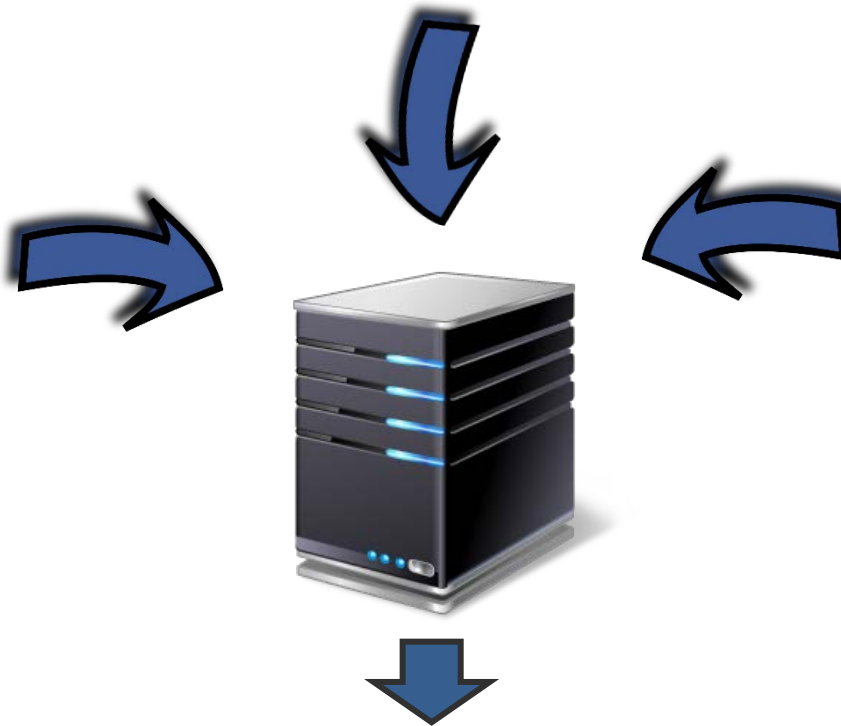


ENERGY CONTROLLING AND MONITORING

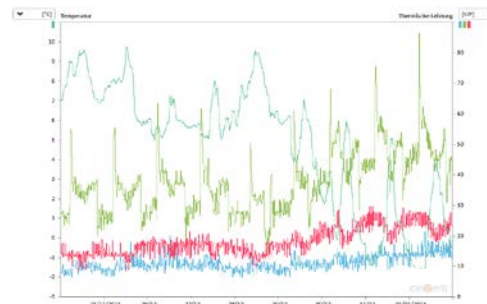
Main Campus Dahlem
260 Meters
→ **Finish: End of 2015**










Campus Düppel
Veterinary Medicine
130 Energy Meters
→ **Finished: 2014**



Campus Lankwitz
Earth Sciences
80 Meters
→ **Planned: 2016**

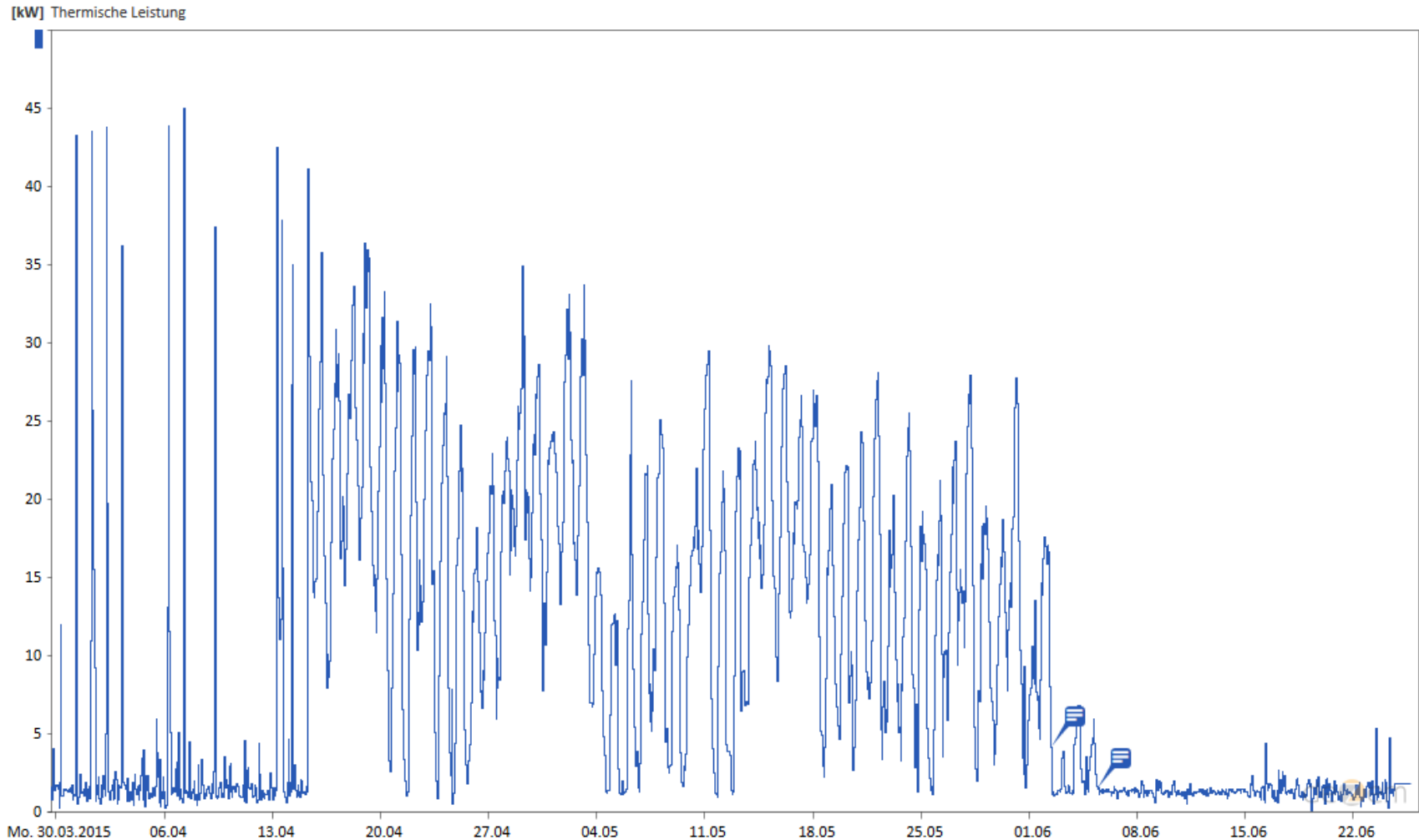


Advantages Online-Monitoring

-  Real-time visualisation of metering readings, power curves and temperatures
 -  Documentation of anomalies and effects of efficiency measures
 -  Detailed weakness analysis
 -  Identification of correction measures and optimisation of the systems operation
 -  Creation of energy consumption balances and energy reports
 -  Automatic alerting if defined limits are exceeded and if meters fail
-  **Integration in team communication and decision-making processes**

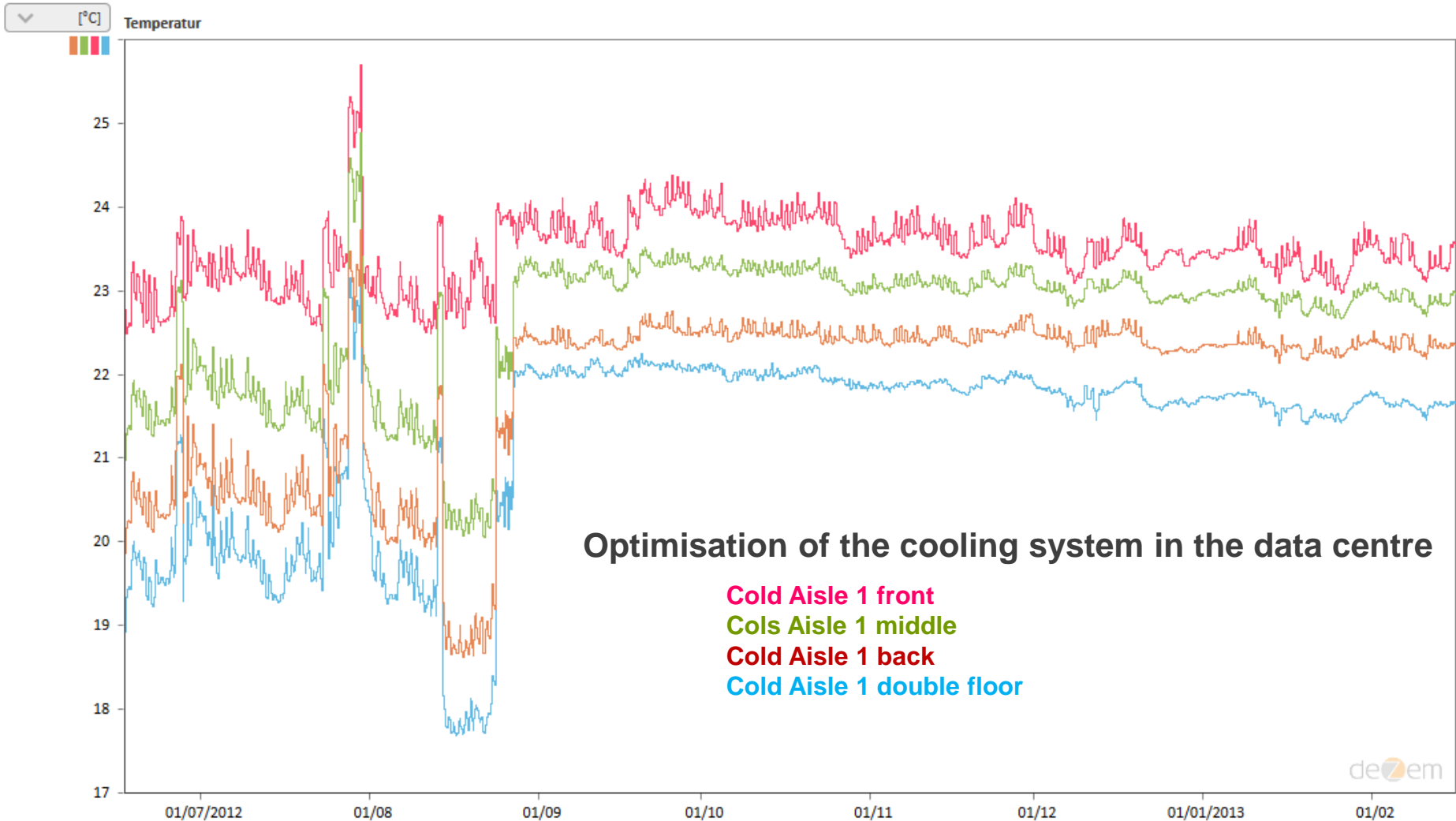
Example

Ventilation System of a lecture & course room

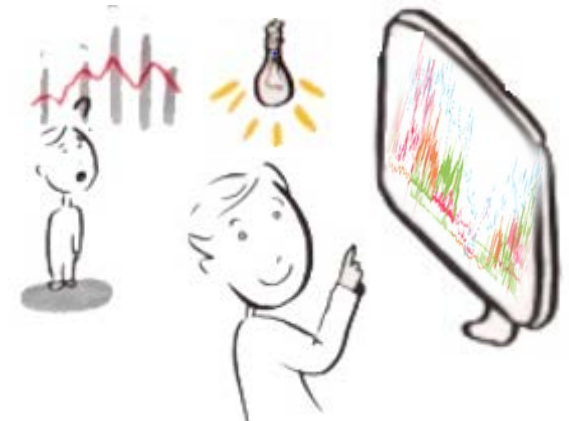
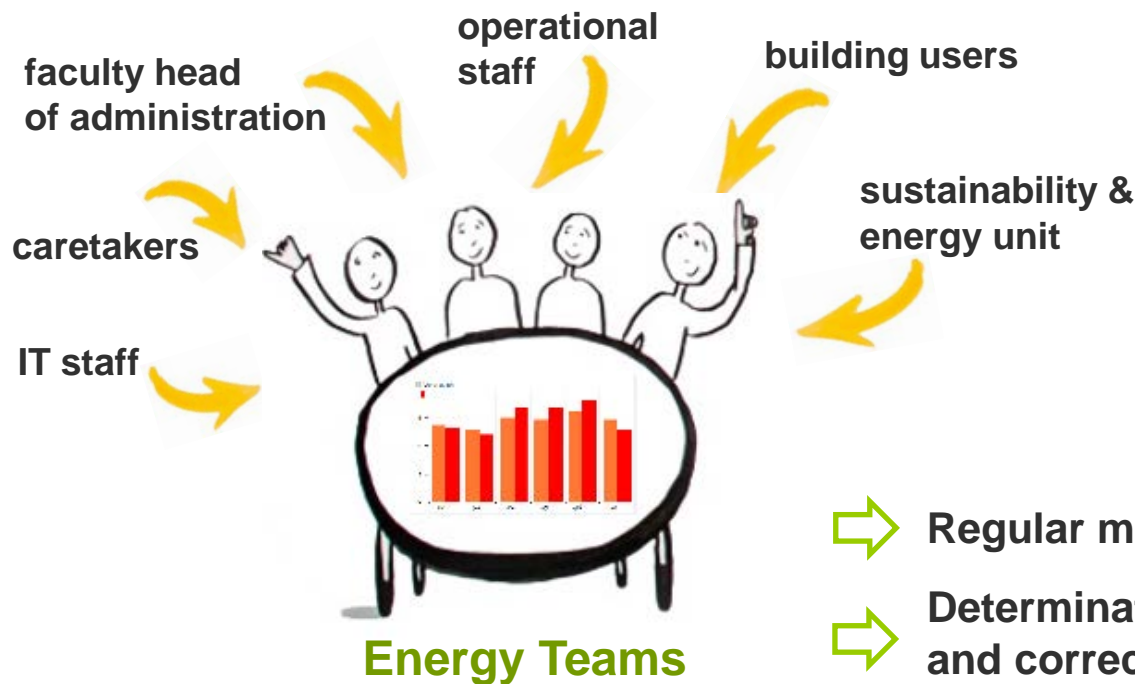


Example

Monitoring Data Centre



Integration in Communication Processes



Trainings for the operational staff to work with the online system

- ➡ Regular meetings
- ➡ Determination of optimisation possibilities and correction measures
- ➡ Definition of responsibilities and energy saving programmes
- ➡ Implementation of energy audits

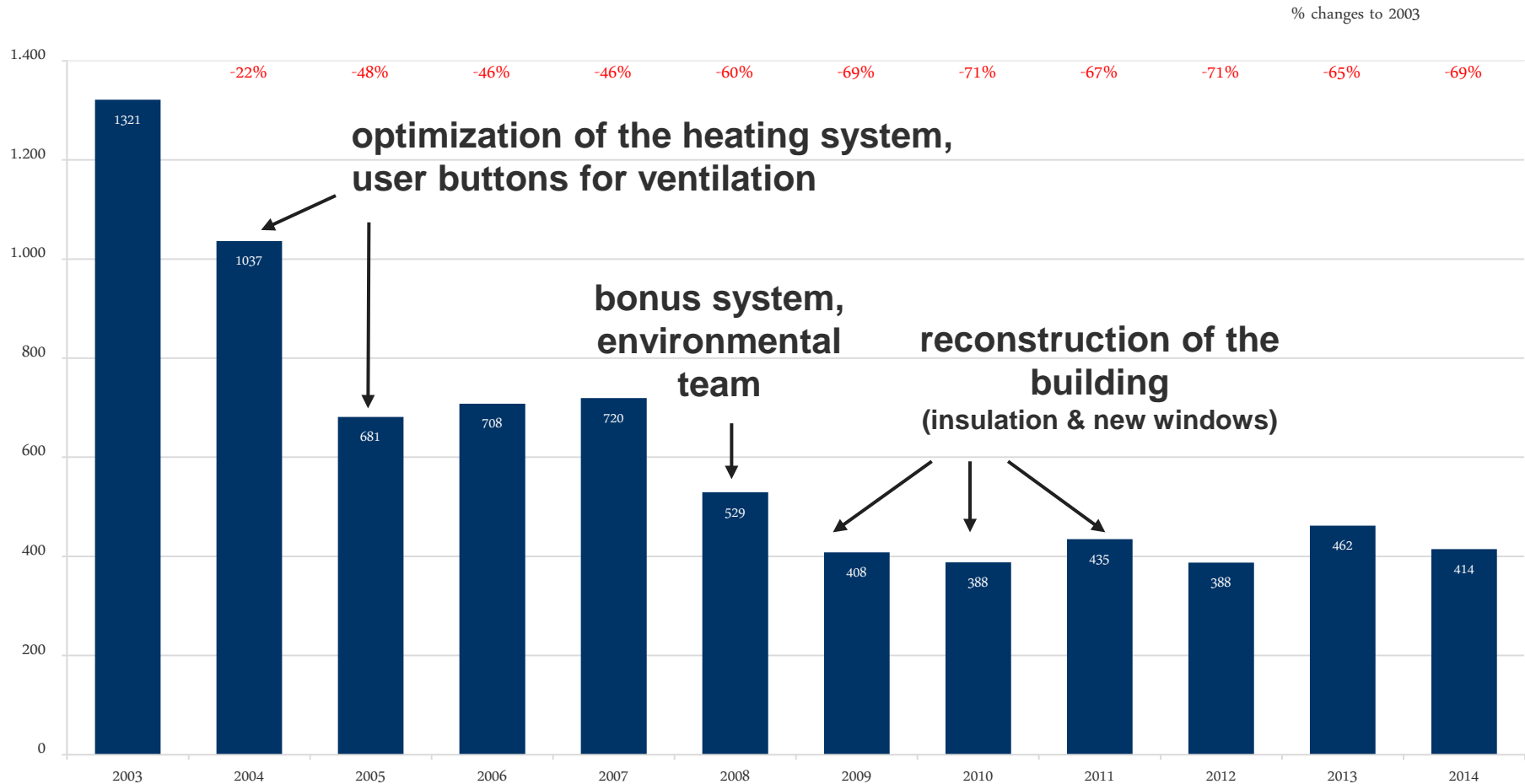


BUILDING ENERGY BALANCES

Institute Building, Faculty of Law

Heat Consumption, 2003 – 2014 in MWh

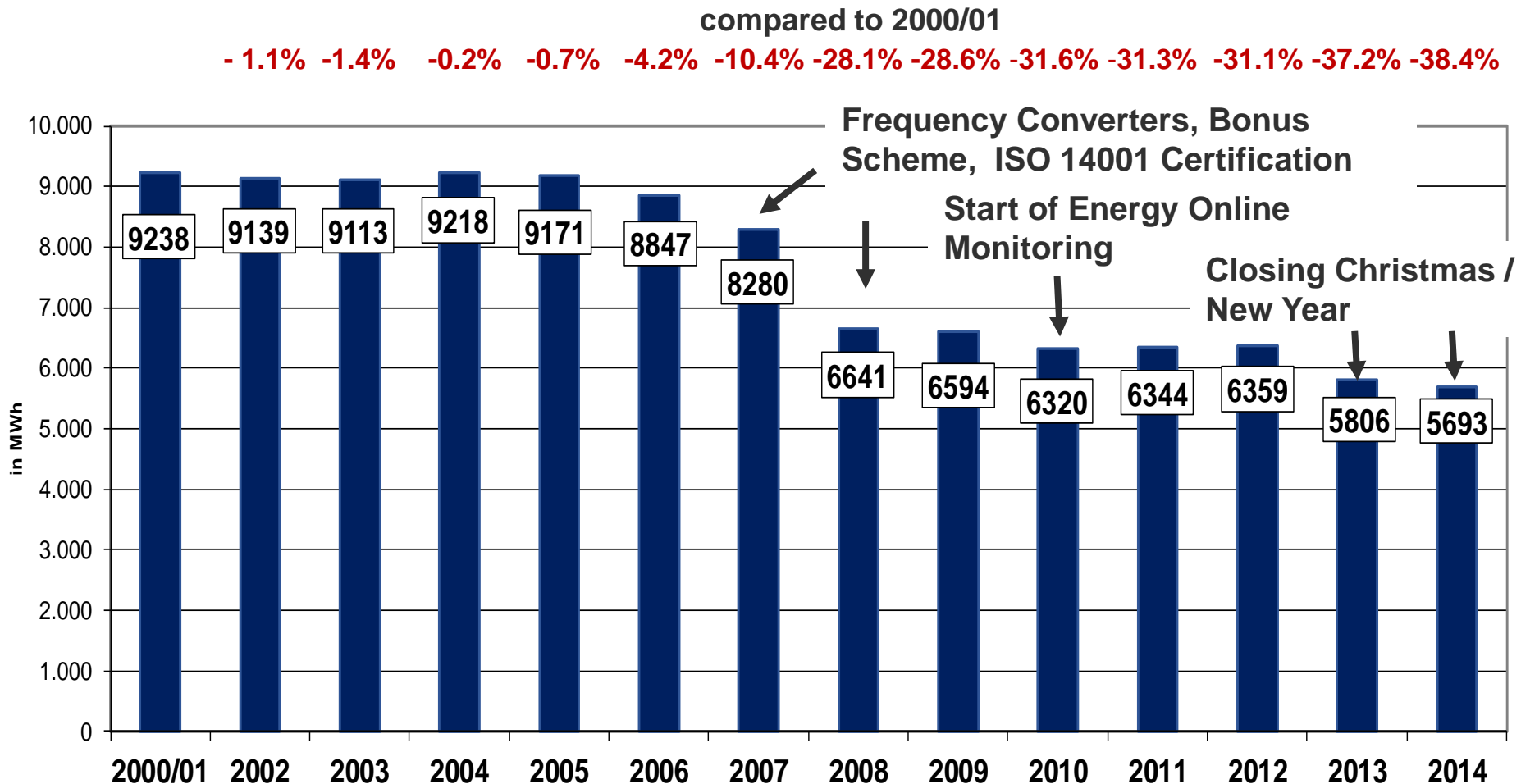
(2003: 139 kWh/m² - 2014: 43,5 kWh/m²)



Chemistry Building

Heating Consumption, 2000-2014 in MWh

(2000/01: 400 kWh/m² – 2014: 246 kWh/m²)



Transforming to Sustainability Management



Quelle: Bernd Wannenmacher



2014/15

Lessons Learned

Combination of different steering
& incentive instruments

Assistance from the top
management,
& direct access to it

Quality of energy controlling &
energy monitoring

Authentic collaboration of
management

Holistic view on technology,
organization & communication

Involvement of all levels
and entities

Broad integration into the
university through team building

Cooperation
with consultants

Thank you very much!



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www.fu-berlin.de/en/sites/nachhaltigkeit

Aspects of Governance

Leadership

Structures and Processes

Board Commitments and Behaviour

Values and Ethical Standards

Transparency & Reporting

Social networking

Communication Policies

Team-Building

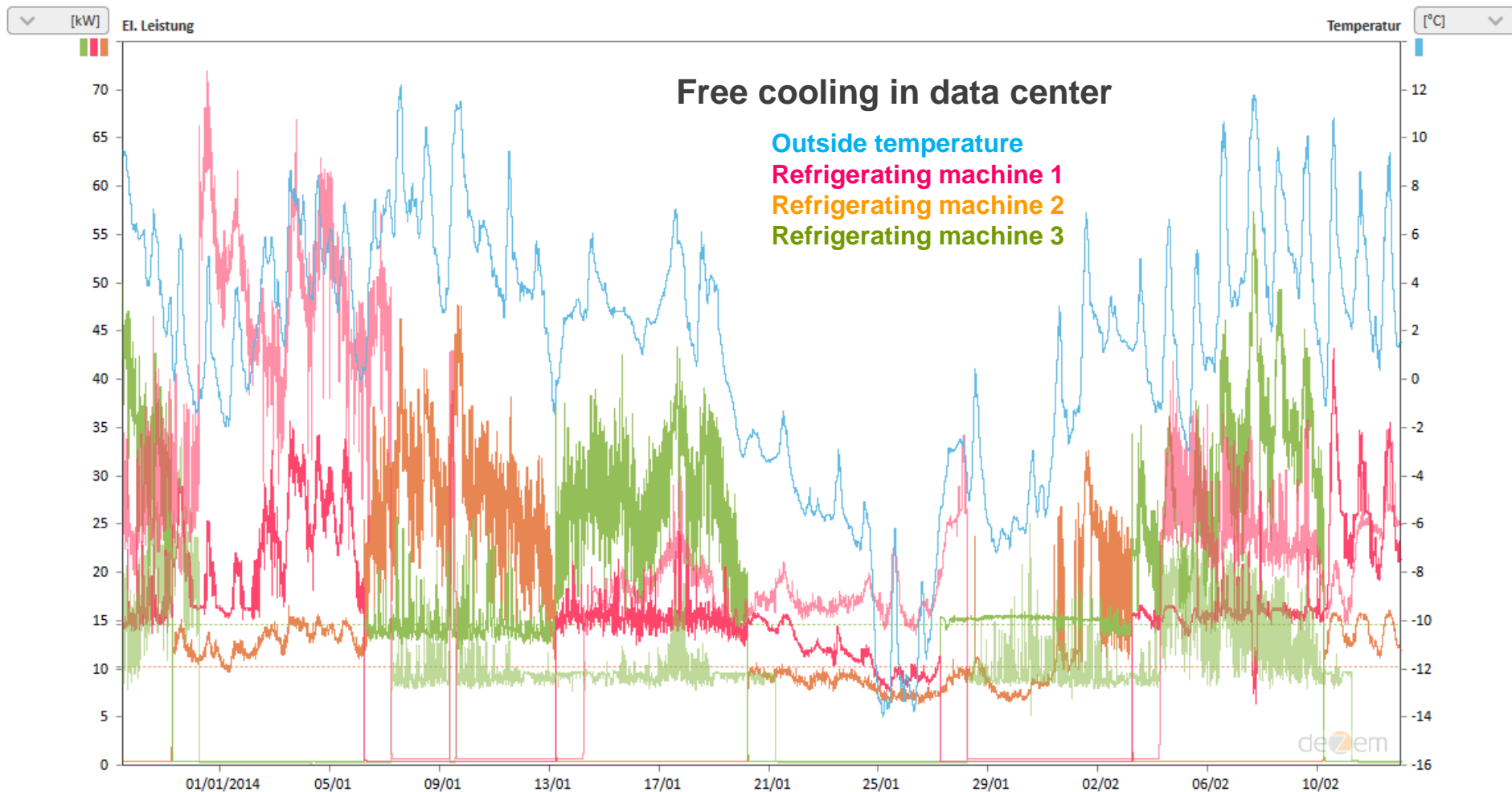
Management System & Standards

Controlling Procedures

Stakeholder Policy

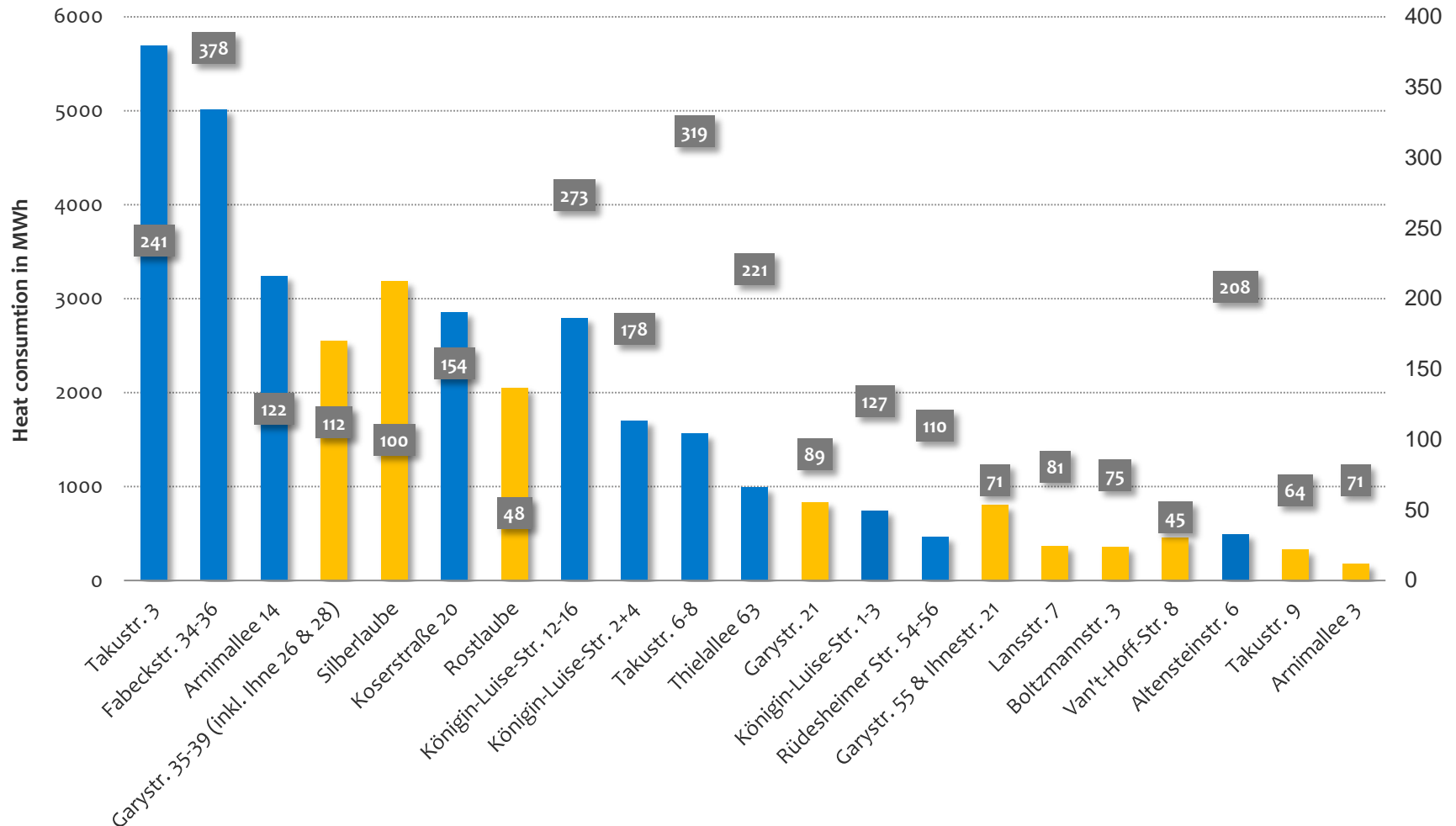
Energy Monitoring Example

Data Centre



Heating Consumption of selected buildings

absolute in MWh und specific in kWh/m² (2013)



Energy Prices

2003-2014 in cent/kWh, prediction for 2015

