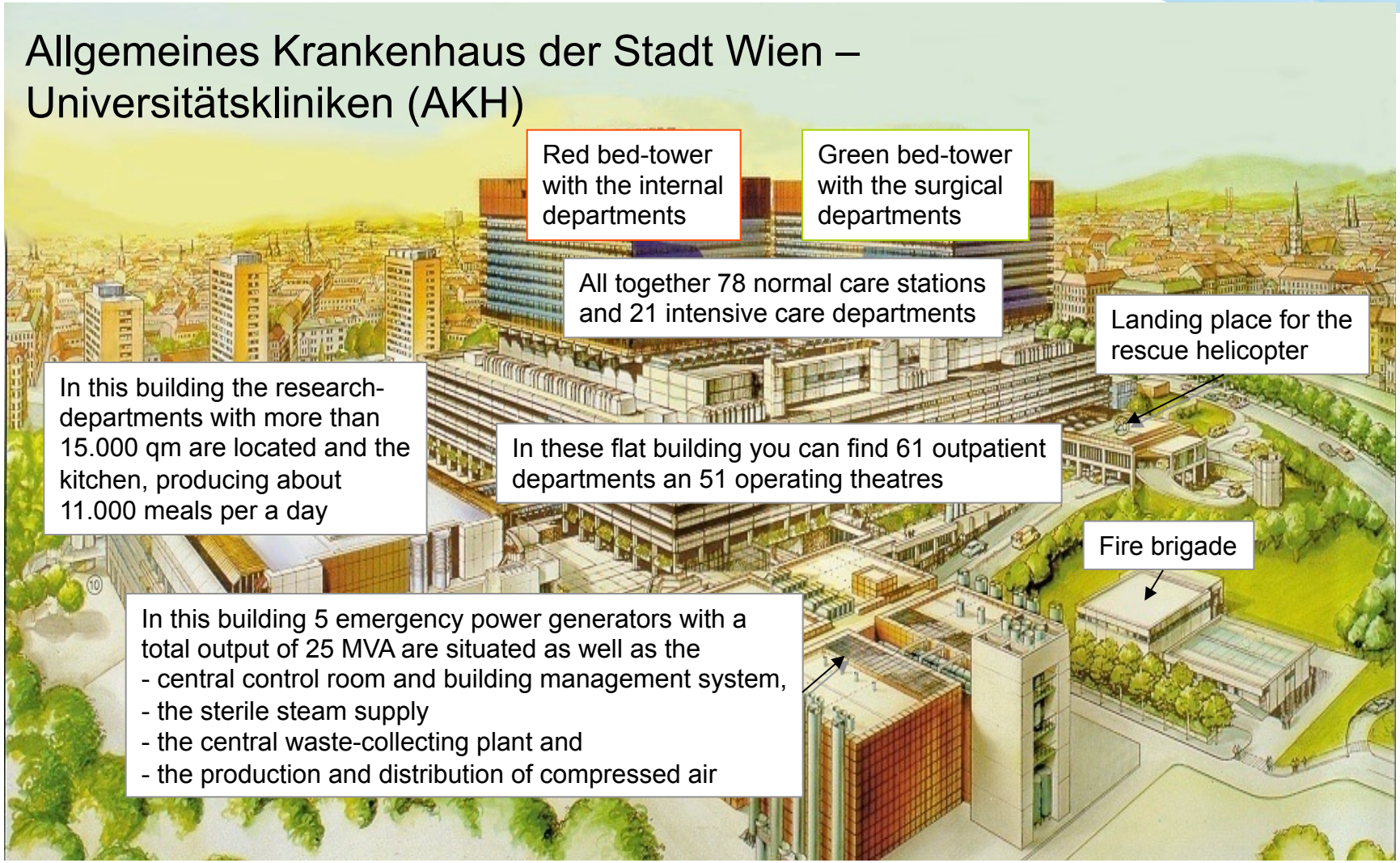
How can Technical Service Departments react to the pressure of ever rising costs?

Obersenatsrat Dipl. Ing. Eduard Frosch
VAMED-KMB Krankenhausmanagement und Betriebsführungsges.m.b.H.

health. care. vitality.

Vienna General Hospital

Allgemeines Krankenhaus der Stadt Wien – Universitätskliniken (AKH)



Vienna General Hospital in figures

Doctors	1.448
Nurses	2.846
Medical Staff	1.618
Administration and Services	2.925
VKMB – Technical Services	920
Total	**9.757**

Stationary Patients	103.000
Out-Patients	1,6 Mio.
OC	51
Number of beds normal care	1.783
Beds for Intensive Care	165
Intermediate Care	97
Day Care	92
Total No. of beds	**2.137**

Vienna General Hospital in figures

- 31 University Clinics and institutes
- 42 Clinical Departments
- 61 outpatients' department
- 337 special outpatients' department
- 51 operating theatres
- 78 Normal care Stations
- 21 intensive care Stations
- 83 general Care Stations
- 1.792 Examination and treatment cubicles
- Catering: 11.000 meals a day
- Pharmacy with production facilities
- IT – Centre
- Indoor parking for 2.500 cars

- 6 lecture halls & 40 practice rooms for 3.000 Students
- 11 Academies and 4 training schools for another 1.300 trainees
- 3 Libraries
- 37 Buildings
- With up to 25 floors
- 27.000 rooms
- 793.060 m^2 Net Occupiable Area
- 240.000 m^2 Surrounding Grounds

Technical services and biomedical equipment

VKMB maintains and administers buildings systems and equipment with a Current Replacement Value of 4.500 Mio. € and assures quality and reliability of services

Building Construction: 1,75 Mio. €	Biomedical Equipment: 620 Mio. €	Technical Services & Systems: 2.200 Mio. €

- 52.800 pieces of biomedical equipment
- Building Management System with 54.700 DDC data points
- 2.200 beds, 103.000 stationary & 1.600.000 out-patients a year
- 1.500 Ventilation and air conditioning units
- 135 Elevators, 12 Escalators and moving walk ways
- Automated container transport system with 2.500 transports a day
- Small container transport system with 4.800 transports a day
- 110 cooling – deep freezing and incubator rooms
- 7 emergency power generators with a total output of 30 MVA
- Water-, Steam-, Compressed Air and Medical Gasses distribution
- Garbage shoots with centralized automated garbage collection
- Fire detection system with 30.000 sensors
- 60.000 Sprinkler heads

Services provided by VAMED-KMB

- Building management
- Maintenance
- Biomedical Equipment mai
- environmental managemer
- Waste management →
- Energy management
- Project management →
- Architectural design and pl
- Dealing with regulatory authorities
- Training and consultant services
- Quality management

In a hospital this size, you will find waste from the rather ordinary to the most sensitive.
We handle 54.000m3 or 5.300 tons of waste per year.
By means of waste separation approximately 1/3 can be recycled.

In this hospital we handle all projects, new constructions and modernization in general. This has the advantage that "FM – Know How" and our knowledge of hospital operation specialities can be integrated into the projects.

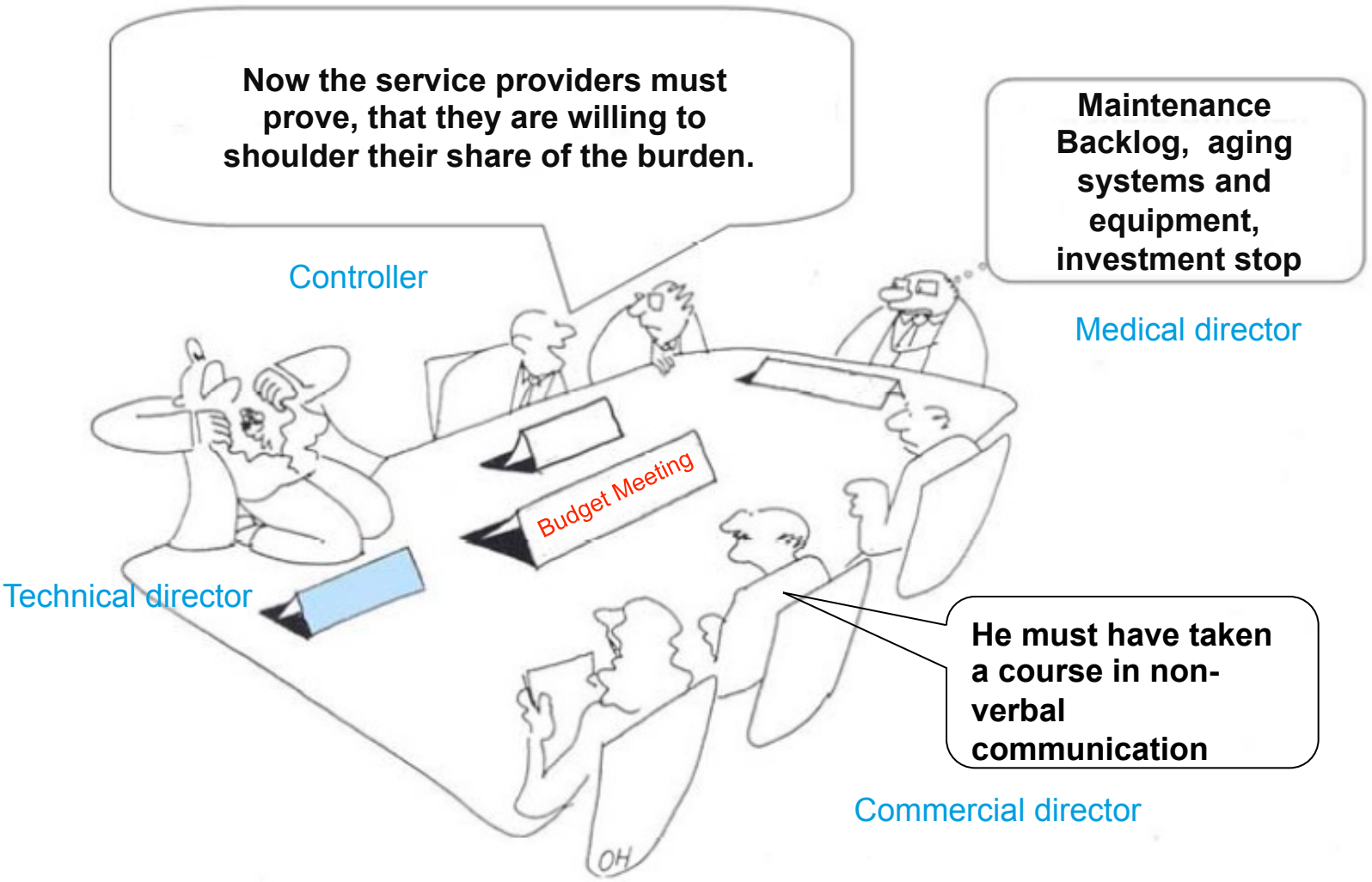
- Accreditations for testing and
- chboard
- g and winter services
- Archiving of medical records
- Tracing inventory and maintaining floor space data base
- 24h a day call center and emergency services.

Potential Risks

I. Unforeseen breakdown of essential hospital equipment necessary for continuous hospital operation.

II. The pressure of rising costs in the health care industry results in an ever increasing pressure on budgets of the technical departments.

Pressure of rising costs



Possible formulas for success

- **Reengineering of maintenance manuals and Standard Operating Procedures (SOPs)**
- Weak - point analysis & Continuous Improvement Process
- Facility Audits & Risk Management
- Management by objectives
- Renegotiation of maintenance contracts
- Alterations of Service Level Agreements (SLAs)
- Energy, utilities and facilities monitoring

Determining factors affecting SOPs

- Customer requirements regarding availability and reliability of systems and equipment and their impact on maintenance intervals
- Prerequisites for maintainability (such as availability of spare parts, accessibility of equipment)
- Monitoring systems and availability of data (such as vibration measurement, operating-time metering) – that means condition based maintenance
- Useful technical life-cycle of systems and equipment
- Manufacturer´s maintenance guidelines

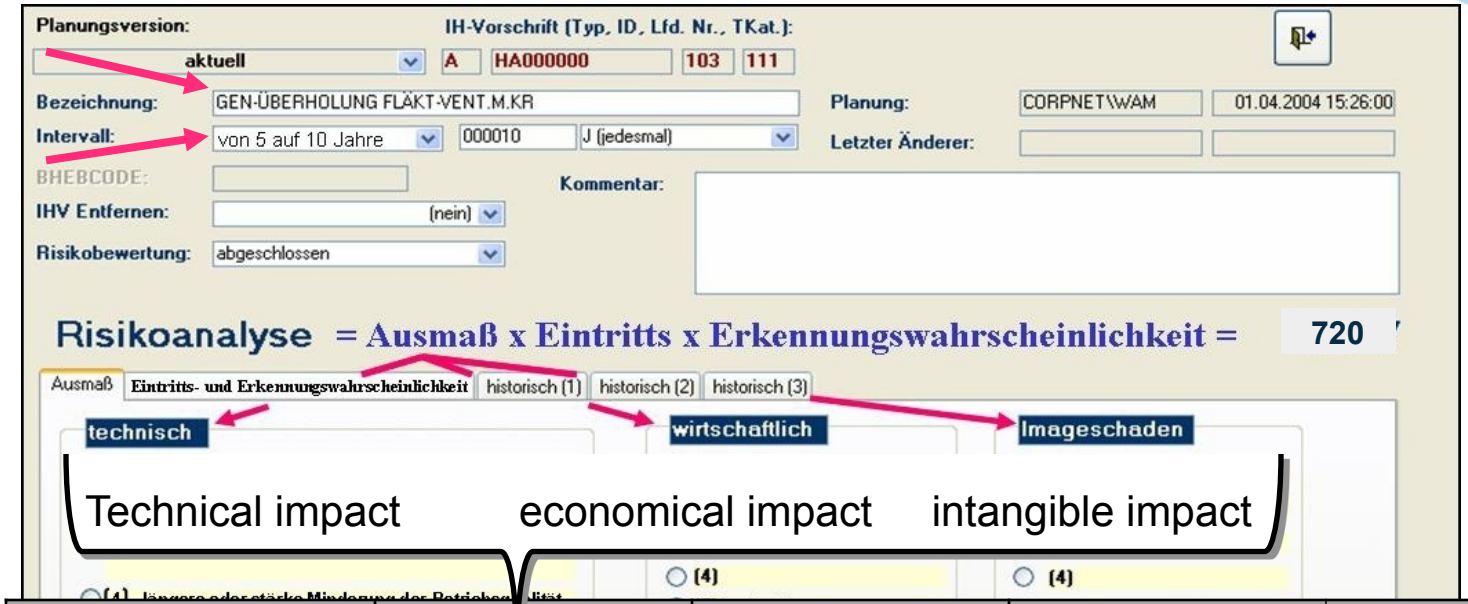
Reengineering of maintenance manuals

In risk assessment, the score is determined as the product of

severity of Impact **x** probability of occurrence **x** likelihood of timely detection

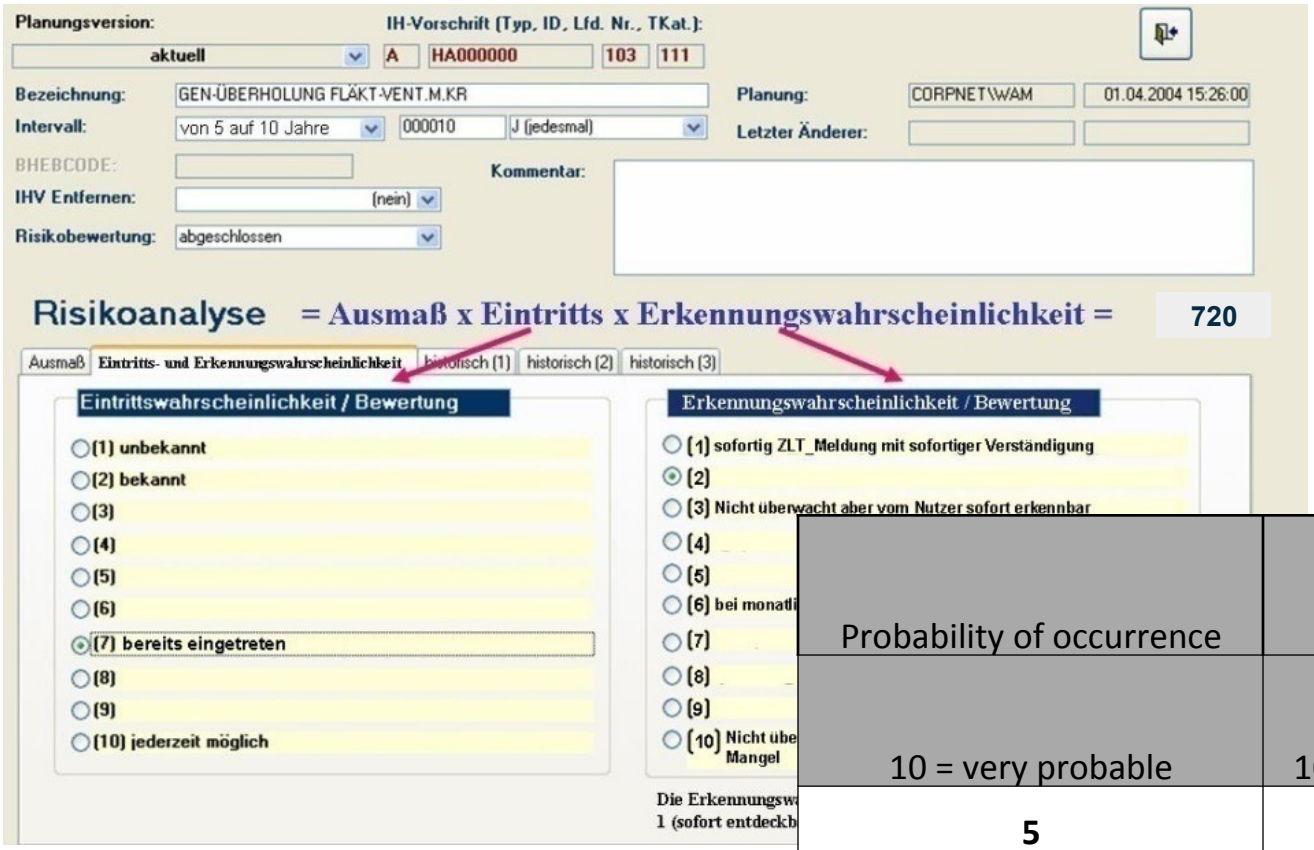
The individual scores are entered with values ranging from 1 to 10 (non existent to very high) – resulting in a final score in the range from 1 to 1.000

Reengineering of maintenance manuals



Systems or Equipment	Severity / Impact 10 = high impact	Probability of occurrence 10 = very probable	Likelihood of timely discovery 10 = early warning unlikely	Score Impact* prob.* discovery = score	Action to be taken
ABCD	**2**	**5**	**3**	**30**	**OK**
XYZ	**10**	**8**	**9**	**720**	**NO**

Reengineering of maintenance manuals



Probability of occurrence	Likelihood of timely discovery
10 = very probable	10 = early warning unlikely
5	**3**
8	**9**

Optimization Ventilation system, with adjustable blades

Up to now the service interval of 295 ventilators was 5 years.

Excerpt from the proposed SOP optimisation:

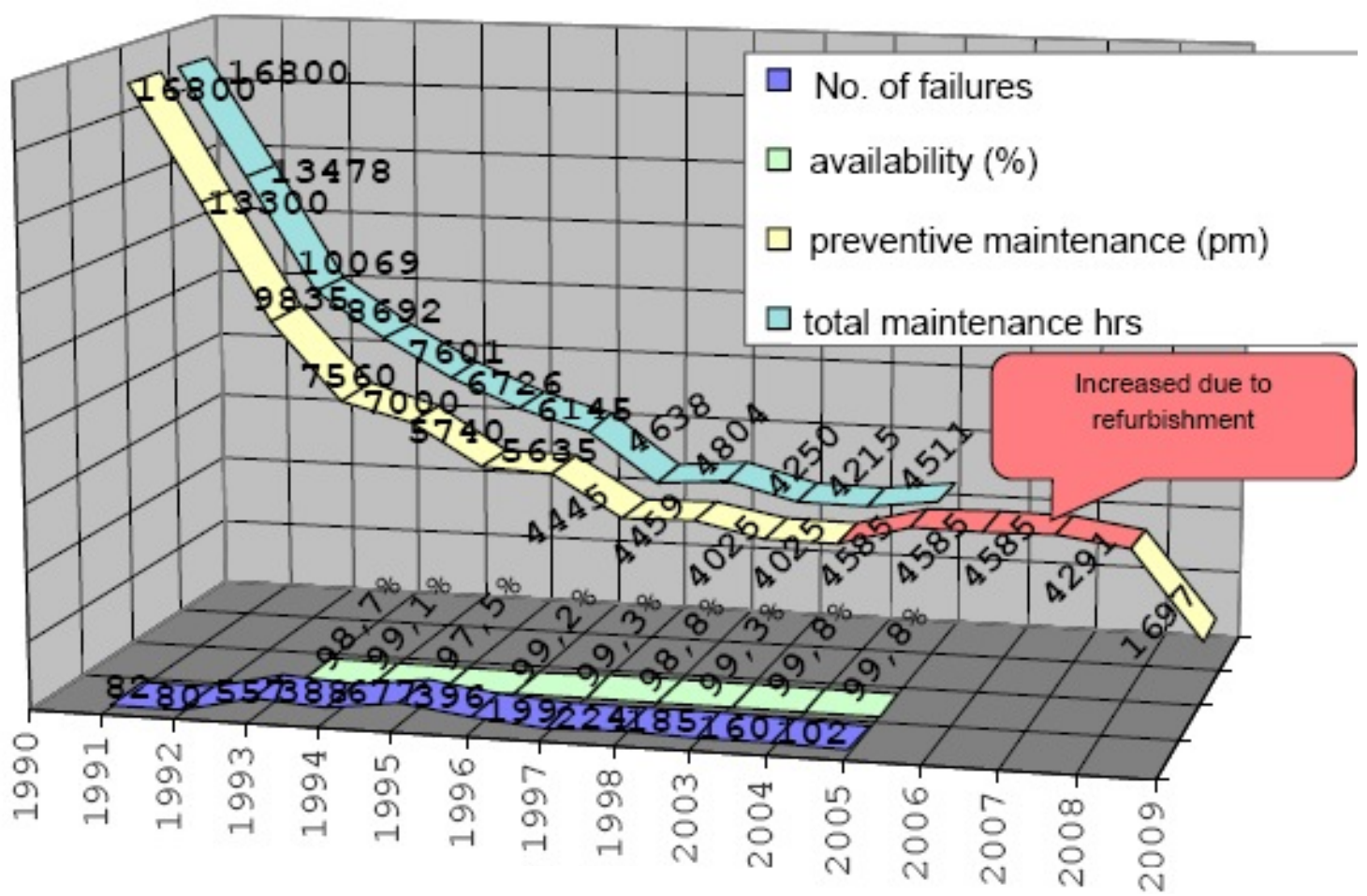
- Modification of bearings
- Brass sleeves for membrane cover
- Dirt repelled coating of ventilator blades
- Improvement of lubrication system

Based on the measures taken, the service interval could be increased from 5 years to 10 years.

Team bonus: € 6.108.-

Cost savings: € 24.436.-

Reengineering of maintenance manuals



Decrease in the cost of maintenance required for 350 axial ventilators

Risk-based Maintenance

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Triggers of weak-point analysis

- Benchmark Gap (undesirable changes)
- Break down analysis
- Monitoring work orders (CMMS, CAFM), shift records, etc.
- Results from Facility Audits
- Customer complaints
- Insurance claims
- Comprehensive systematic weak-point analysis with specialized tools, essentially consisting of:
  - Stock-taking (listing all systems and equipment)
  - Quantitative and qualitative assessment of equipment failure
  - conditions assessment and analysis of all facts leading to common failure, where necessary: find solutions
  - Take action
  - Monitor results

  Within the VAMED-KMB, the systematic weak-point analysis is regulated and defined in process flow charts and Standard Operating Procedures.

The benefits of weak point analysis:

- Securing and improving availability and reliability of facilities for the long term
- Reduction of breakdown- frequency and / or extent of damage
- Improve productive capacity of technical services department
- Controlled change of key performance indicators (such as maintenance per unit)
- Derive / adjust maintenance guidelines and strategy
- Reduction in service costs
- Targeted equipment and plant improvement
- Assessment of investment, renewal and replacement requirements
- Rethink previous “make or buy” decisions
- Aiding long term staff development and planning

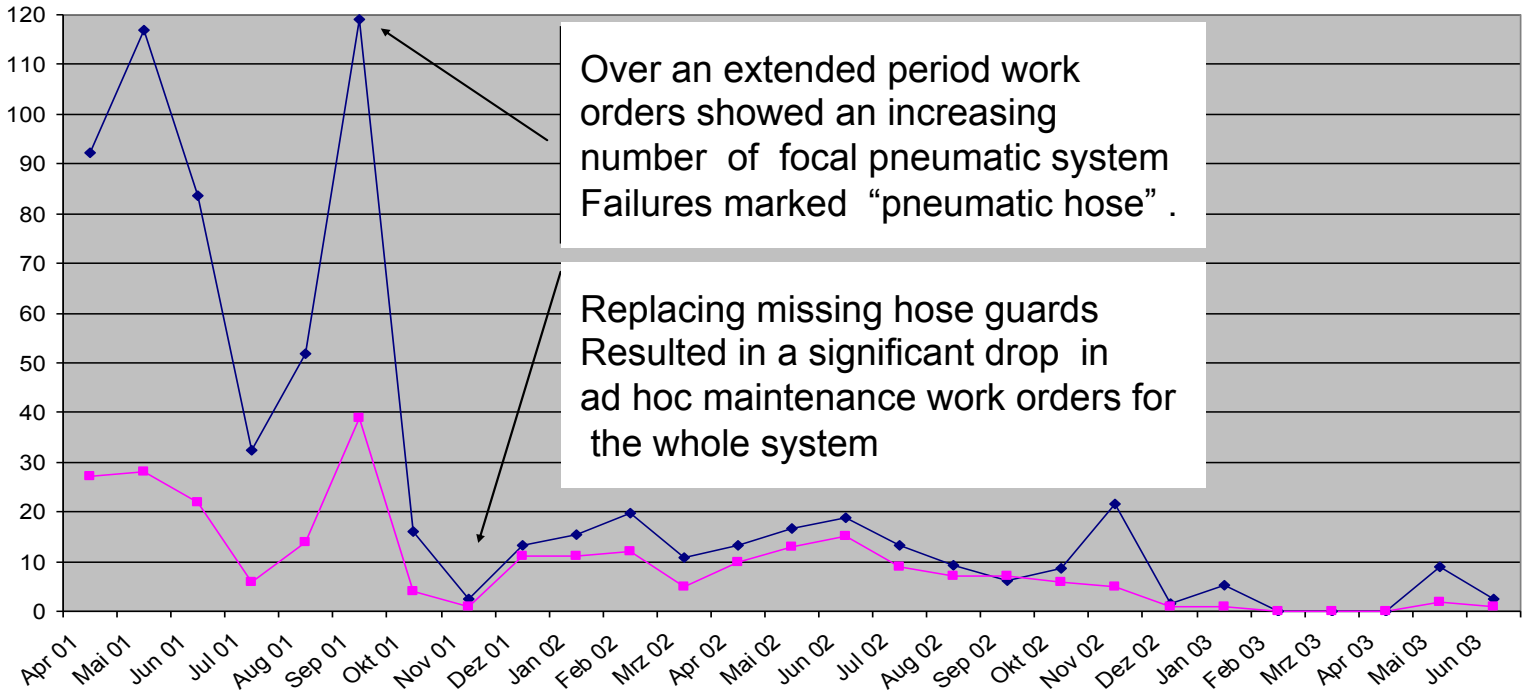
Spiral-type hose guard

Adding missing hose guards

Sample of implementation

Ad Hoc maintenance requirements of pneumatic control system hoses

OF2 NB - pneumatic control system



	Apr 01	Mai 01	Jun 01	Jul 01	Aug 01	Sep 01	Okt 01	Nov 01	Dez 01	Jan 02	Feb 02	Mrz 02	Apr 02	Mai 02	Jun 02	Jul 02	Aug 02	Sep 02	Okt 02	Nov 02	Dez 02	Jan 03	Feb 03	Mrz 03	Apr 03	Mai 03	Jun 03
Std	92,3	117	83,5	32,5	51,8	119	15,9	2,5	13,2	15,3	19,6	10,7	13,2	16,6	18,8	13,3	9,3	6,25	8,5	21,5	1,5	5,3	0	0	0	9,05	2,5
Anz.Aufträge	27	28	22	6	14	39	4	1	11	11	12	5	10	13	15	9	7	7	6	5	1	1	0	0	0	2	1

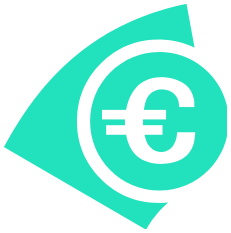
Calculation of bonuses for adopted proposals

Bonus payments to staff members:

For all actually adapted proposals, which are economically justified (where the benefit can be calculated), a bonus is paid to the staff submitting the proposal. The staff receives a bonus of 25% based on the proven benefit in the first year.

This rule applies to all proposals, whether savings are generated only once or whether continuous savings are achieved.

Bonus = 0,25 x (Savings – 0,5 x cost of implementation)



Renovation of Showers

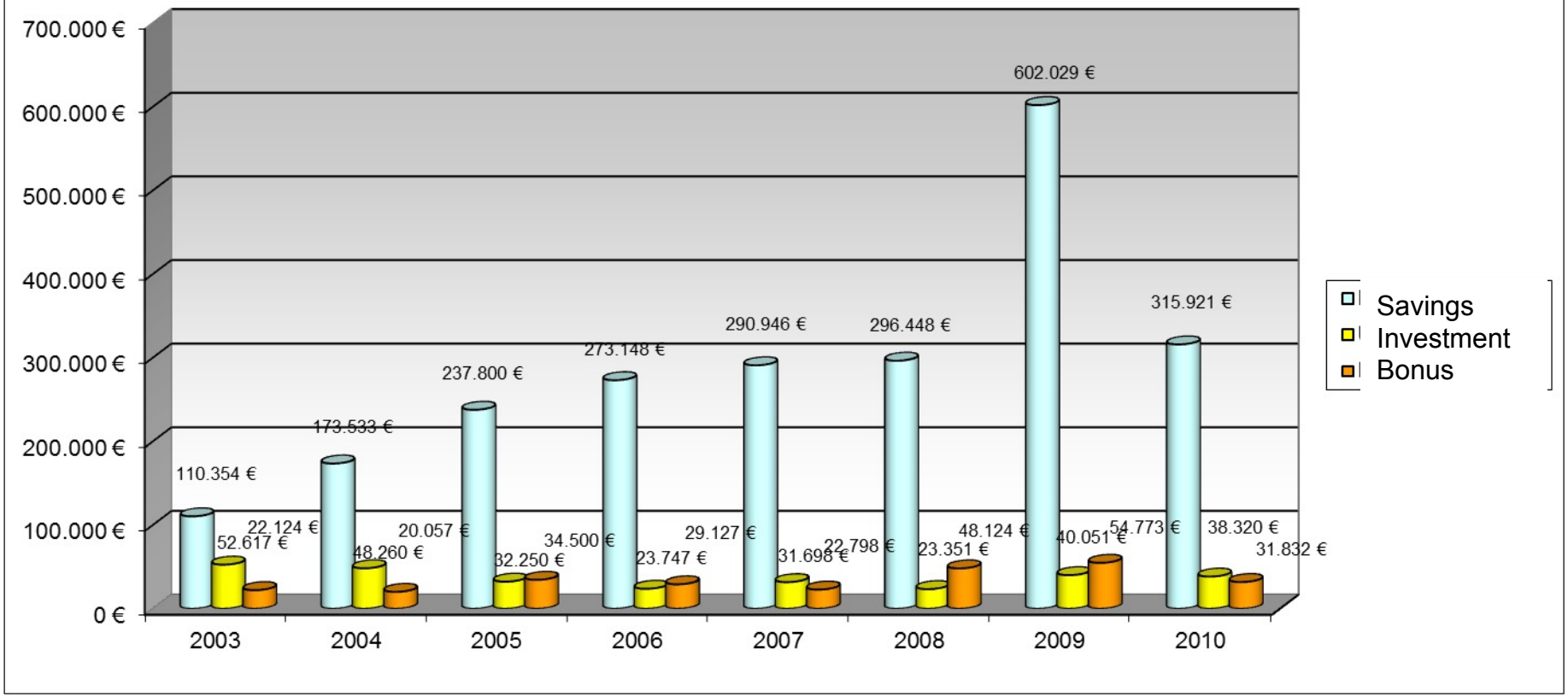
After long term intensive use, the shower tubs corroded heavily under cover strips and tiles. The planned renewal and replacement was economically not feasible.

The proposal was: Remove shower tubs and tiles and replaced them with a jointless multi-layer epoxy coating in a new and appealing design.

The result: a cost-effective, easy to clean and durable replacement. In the meantime 250 units have been rebuilt.

1st year benefit: € 171.508.-

Continuous Improvement Process Statistic 2003 to 2010



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What is Risk?

If we are unsure what will happen and furthermore we are not aware what is the probability of occurrence: "is called uncertainty…"

Brühwiler (2003) defines: But risk is „…the knowledge of a potential threat for a system or an organization, the frequency (expectation of occurrence) and consequence on a system or an organization"

Risk Management: a way to secure profit performance

VAMED

Conducting facility audits

- Analyzing system parameters and actual customer requirements
- Examining the Maintenance Strategy actually in place
- Questioning optimization and improvements that have been implemented
- Verification of energy management results
- Check and monitor the quality & condition of service and repair equipment
- Review all efforts to sustain long-term maintenance and plant operations
- Check, whether Systems and Equipment documentation is complete and current
- Review emergency preparedness plans and standby plants, systems and equipment

Risk Management: a way to secure profit performance

The aim of facility audits

- Highlight potential for improvement and optimization as well as deviation from agreed standards
- Promote the maintenance of service security
- Support efforts to secure economically justifiable long-term systems and equipment operation
- Aid the planning and controlling process of maintenance and building management
- Intensive effort on the part of the “system owner” (of the one in charge of a system or equipment) to come to terms with the contents of the facility audit (including qualification of staff, standards, documentation etc.)

Central Control Room

Building Management System:
By the end of 2009:
54.700 data points

Building Management System

The building management system controls the technical equipment and systems of the Vienna General Hospital and monitors some of the biomedical equipment.
Monitoring and operating the Systems without the Building Management System in an orderly & controlled manner is nearly impossible.
Only constant monitoring and timely discovery of break downs / equipment failures by means of the BMS can prevent serious damage and avoid endangering patients and staff.

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Building Management System

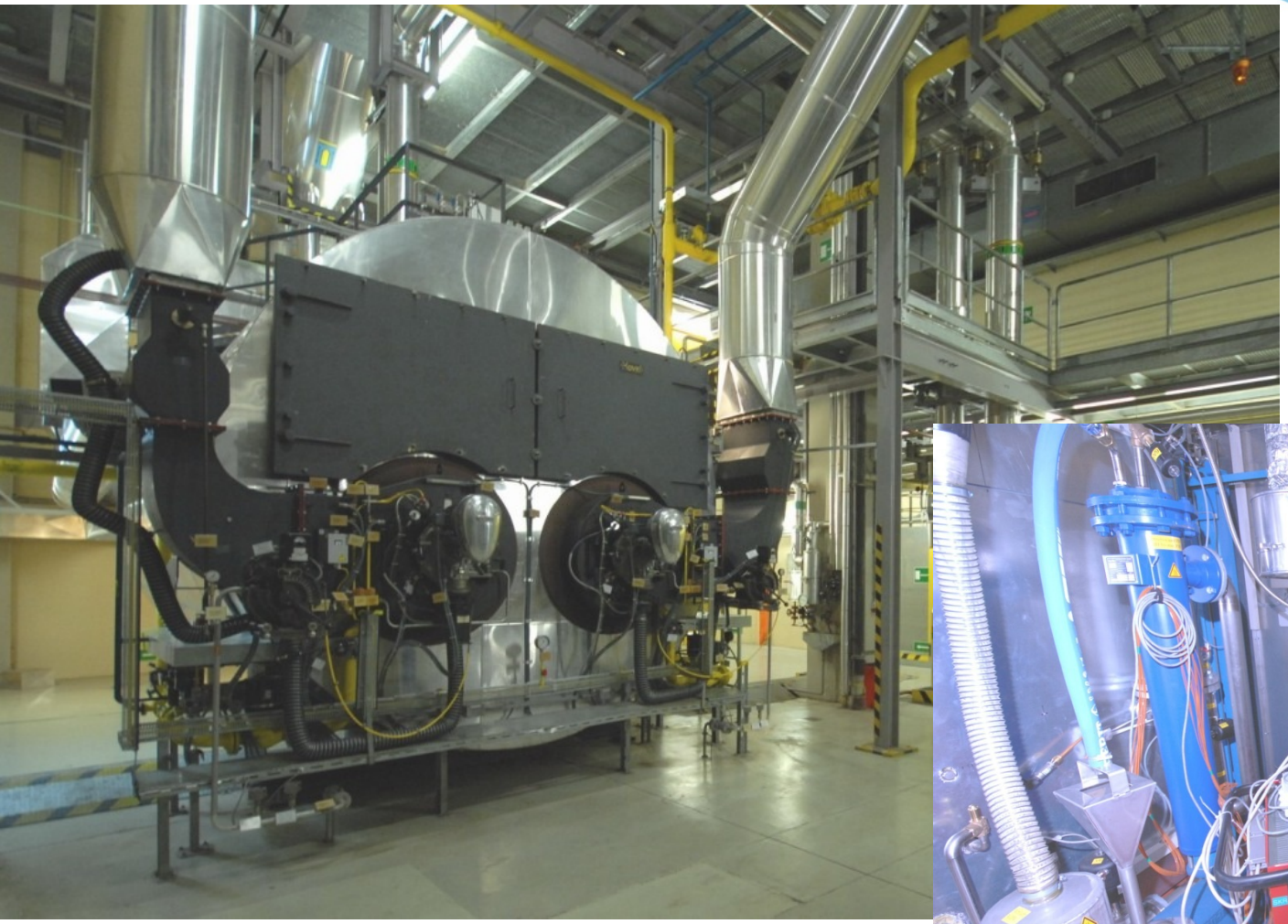
Original design: 1986 -1987 Construction and implementation: 1987 -1989
Commissioning: 1989 Technology: from the 80´s
Age: 19 to 21 years Actually in use: 19 years
Total cost of renewal and replacement project: . € 3,825 Mio.
Project implementation in 3 steps over a period of 6 years

“If the renewal and replacement of the BMS – central computer unit is not planned and implemented in time, a breakdown can lead to significant problems in hospital operations.”

Some samples and risks:
•Failure in monitoring biomedical devices such as freezers and deep freezers (potential damage in the millions, due to loss of scientific research material and data, endangering the medical supplies for patients if a large number of stored blood units become unusable)
•Unnoticed loss of electric power in case of UPS failure and subsequent loss of data and intensive care monitoring
•Loss of utility and media monitoring capability (Gasses, including medical gasses, potable water, sterile steam, sterilisation etc.)
•HVAC - Recovery after power loss was extremely time-consuming as each unit required a
“If the renewal and replacement of the BMS – central computer unit is not planned and

implemented in time, a breakdown can lead to significant problems in hospital operations.”

Sterile Steam Supply



Sterile Steam Supply

Sample: Steam for Sterilization

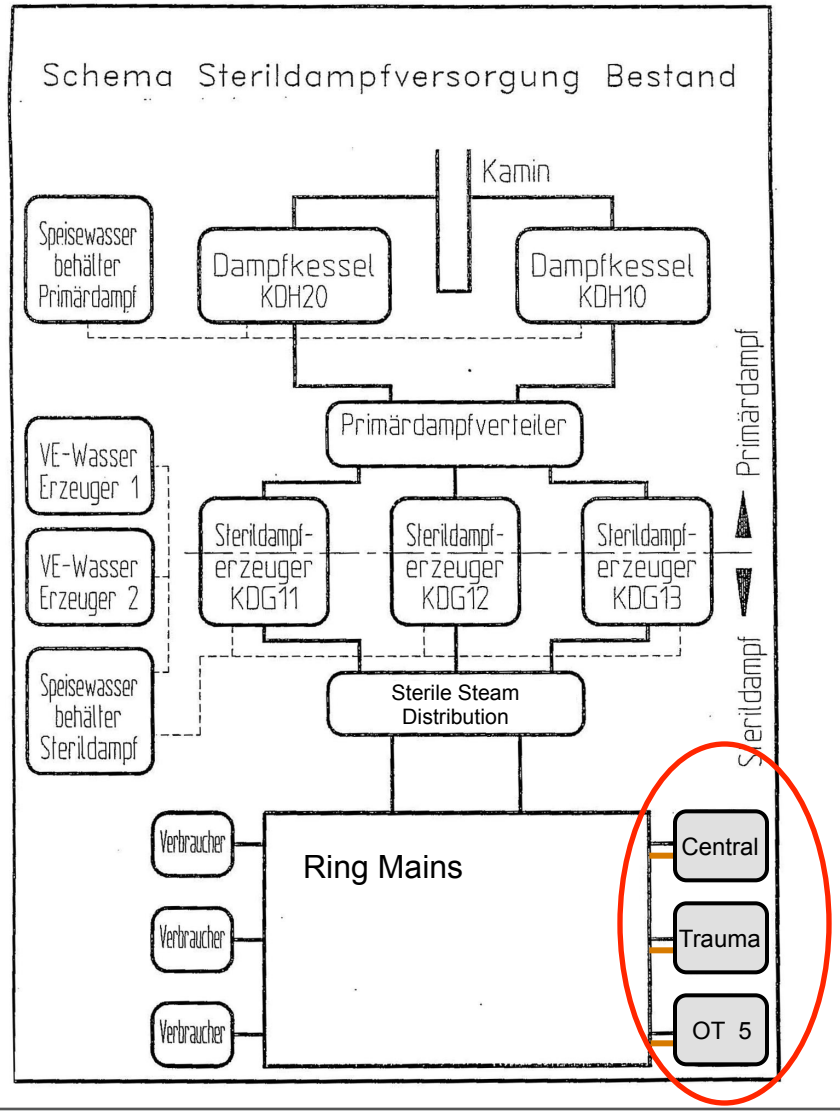
For the following areas, the hospital requires a continuous supply of steam for sterilization, 24 hours 365 days

- central sterilization
- trauma surgery
- sterilization of medical instruments in the Operating Theatre No. 5

Situation at the outset:
2 steam boilers, 10,5 MW each, produce primary steam.
Boilers are equipped with 2 burners each.

Natural Gas serves as primary energy. In case gas is not available, the boilers can be operated on fuel oil. In accordance with regulations, feed pumps and condensate pumps have redundant secondary systems.

Sterile Steam Supply



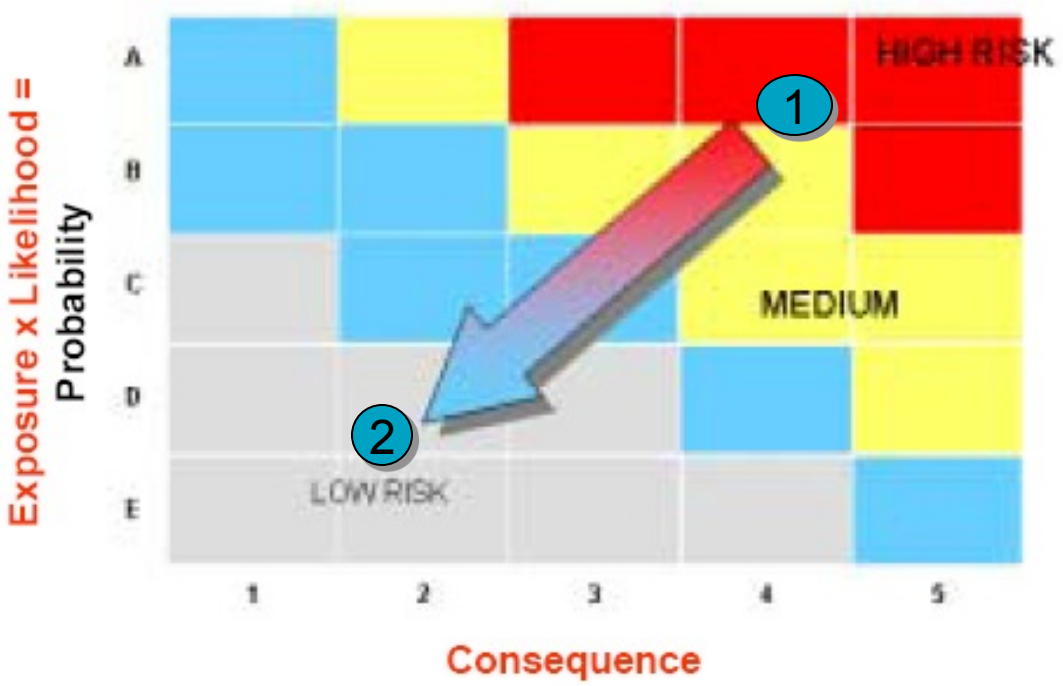
Measures taken:

For the 3 vital areas:

- central sterilization,
- trauma surgery,
- sterilization of medical instruments OT no. 5

a secondary steam pipe system, together with all necessary elements such as valves, etc. were added to the existing single pipe system.

Sterile Steam Supply



1.) Risk of losing sterile steam supply **before** measures were taken

2.) Risk of losing sterile steam supply **after** measures were taken

Audit report – steam for sterilization

Reliability and Availability of the System?

a) What are the requirements of the user with regard to availability and reliability of the system (Steam for Sterilization)?

b) What parameters (with regard to availability and reliability) are the Standard Operating Procedures (SOPs) of the service provider based on?

c) Did requirements change over the last 5 years?

d) Redundant systems, Standby Systems, Back Up available?

Audit report – steam for sterilization

Staff Qualification Requirements. Is the Maintenance Staff sufficiently qualified?

a) Is the present staff qualified?
b) Is alternate qualified staff available?
c) Is an adequate further training program in place?

Is the maintenance program effective?

What are the Key Performance Indicators?
Is an internal monitoring system in place?

Audit report – steam for sterilization

Considering the overall age of the Facility, what proposals for renewal and replacement are on the table?

a) Factors and considerations: …..

b) Are projects and / or proposals already submitted?

a) Storage on site? Delivery time known?

Monitoring: How are deviations from the desired state detected?

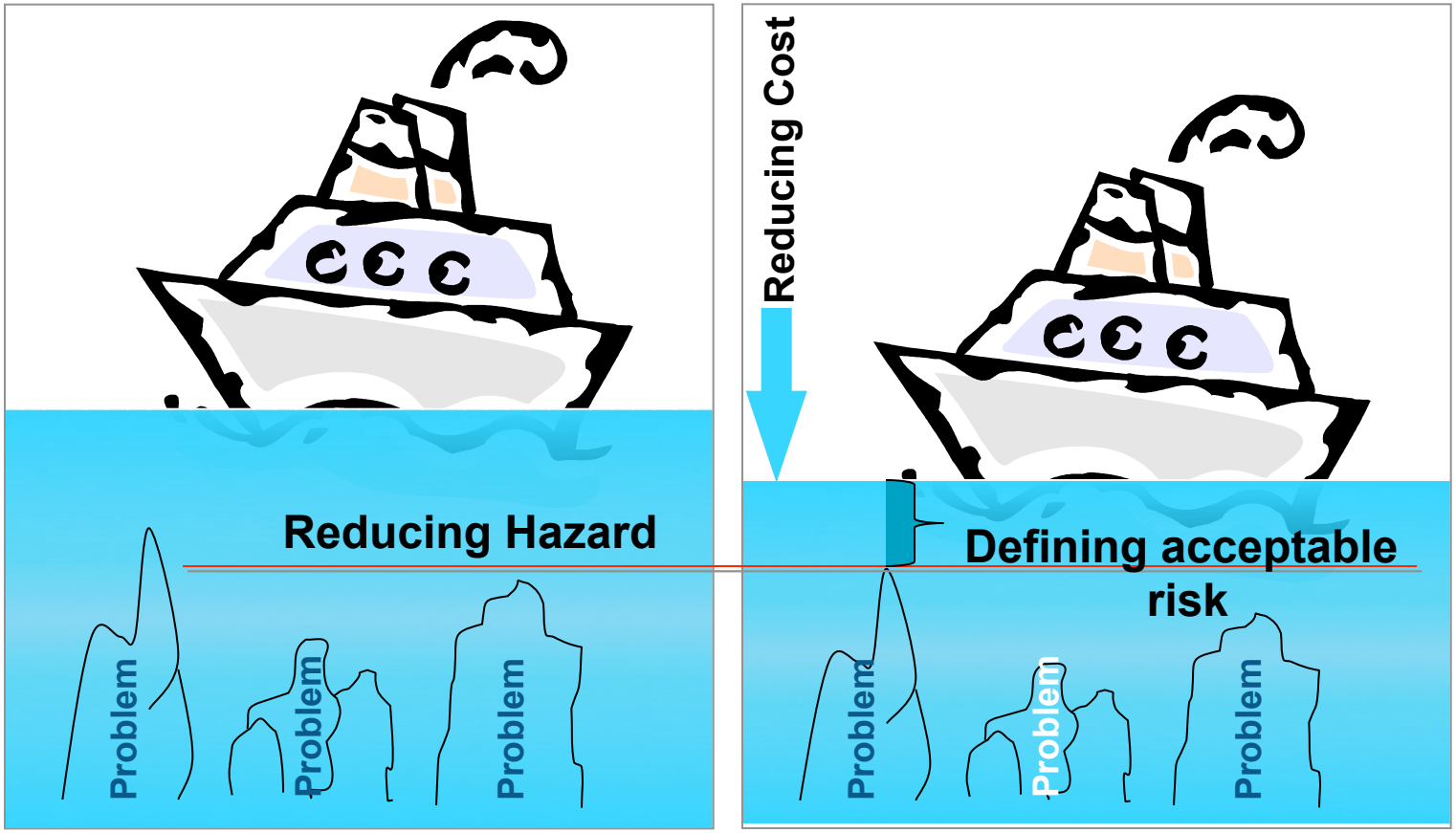
a) Regular inspection and measurements? Interval: …..

b) Building Management System, semi permanent or continuous monitoring?

c) Are observations documented?

e) How are customer complaints handled?

Risk Management



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Management by objective – nonmedical compressed air

Responsible for plant /system operation: Mr. Roland Stangl; Targets for the year 2003

Reliability of services

Target	Unit	Target for the year	Tracking	How (Method of tracking)
Securing the compressed air supply	M3/h/bar	2500-2700/8,5	Continuous	Diagram 1
Prepare a new list of spare parts	-	Concept	One time	Release of concept

Risk Reduction (reduction of break downs)

Target	Unit	Target for the year	Tracking	How (Method of tracking)
Reliability of screw type compressor	%		Continuous	Diagram 2
Reliability of piston compressor	%		Continuous	Diagram 2
Ad Hoc maintenance, break downs, cases per subsystem	cases	Previous year -5%	monthly	Evaluation CAFM - System

Life Cycle Costs, warranty of long term economic plant operation

Target	Unit	Target for the year	Tracking	How (Method of tracking)
well-balanced operation (uniform operation)	%	+ / - 20%	3 month period	Diagram 3
Maintenance expenditures (Staff, Material, Contractors) per subsystem	€	Previous year -5%	Continuous	Diagram 4
Efforts to achieve improvements	hours	150 hours maximum	Per year	Evaluation CAFM - System

Maintaining the Documentation: System and Equipment documentation and history files (BMS & CAFM)

Target	Unit	Target for the year	Tracking	How (Method of tracking)
Update system and equipment documentation		monthly	sample	Self assessment / technical audit
Proper upkeep of system and equipment history files		monthly	sample	Self assessment / technical audit

Clean, orderly, safe, innovative

Target	Unit	Target for the year	Tracking	How (Method of tracking)
Regulatory compliance		monthly	sample	Self assessment / technical audit
Accident prevention (near accidents?, safeguards in place?)		monthly	sample	Self assessment / technical audit
Condition of equipment and systems (orderly, clean etc.)	complaints	0	sample	Inspection & photo - documentation

Excerpt; further points: efficiency, effectiveness, energy consumption etc.

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Renegotiation of maintenance contracts

- **Reduction from a generous (all in) comprehensive service agreements to a standard service contract adapted to fit operational requirements**
- Switching to “pay per use” – compensation models on the basis of actual utilization (for example: x-ray institute)
- Technology – cooperation in the area imaging equipment in connection with comprehensive modernization **->** as elaborated in a recent article in the magazine “Krankenhaus – Technik und Management” August 2009

Renegotiation of contracts, Technology – Cooperation

During the negotiation for the purchase of new equipment, not only the purchase price in the offer was considered. For the acceptance of tender, the following facts were considered as well:

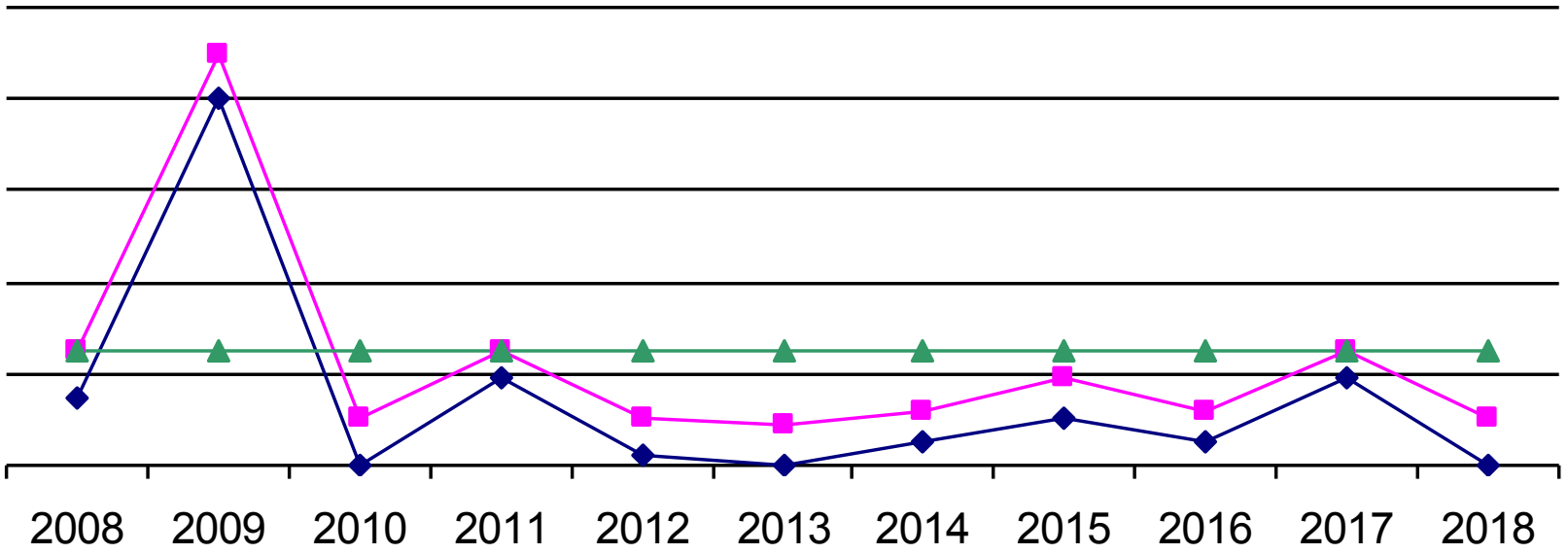
- Are adaptations required, is a new installation required
- How is the “Estimating Useful Life” developing
- Which updates and upgrades are included in the contract
- What is the guaranteed “Up-Time” (reliability, availability of equipment)
- How fast are technical support and services available (reaction time)
- How “User – friendly” and “Patient – friendly” are service periods and timing

For a 10-Year long term contract, it is essential to have access to the newest technology. In addition to comprehensive hardware and software updates and upgrades it is important to maintain a guaranteed functional Quality and long term spare part delivery.

The usual cycle if Investment, maintenance, major repairs, renewal of parts and updates was converted in a yearly “lump sum contract” covering investment and comprehensive maintenance over a period of 10 years.

Ojective achived

Constant lump sum instead of investment peaks



Renegotiation of maintenance contracts

- 12 maintenance contracts for angiography equipment

  Savings

  Cancellation of comprehensive service agreement
  Begin of standard service contract in 2003
  (same successful performance & quality of service
  No “user / customer complaints) **approximately 40%**

- 7 maintenance contracts for computer tomography equipment

  Cancelation of comprehensive service agreement
  Standard service contract (including tube) € 50.190 **approximately 24%**

Renegotiation of maintenance contracts

4 MRI scanner contracts (3 * 3 T, 1 * 1,5 T)

Offer for comprehensive service agreement	x € / per year and scanner
Negotiation result (Without coil and Interface station)	y € / per year and scanner

after due consideration **->** Training of 2 staff members € 70.000.-

Projected result starting 2010 (per unit)

- Standard service agreement
- In house service (staff)
- Material
- Service key approximately € 50.000.-

Projected savings approximately € 20.000.- per year and scanner

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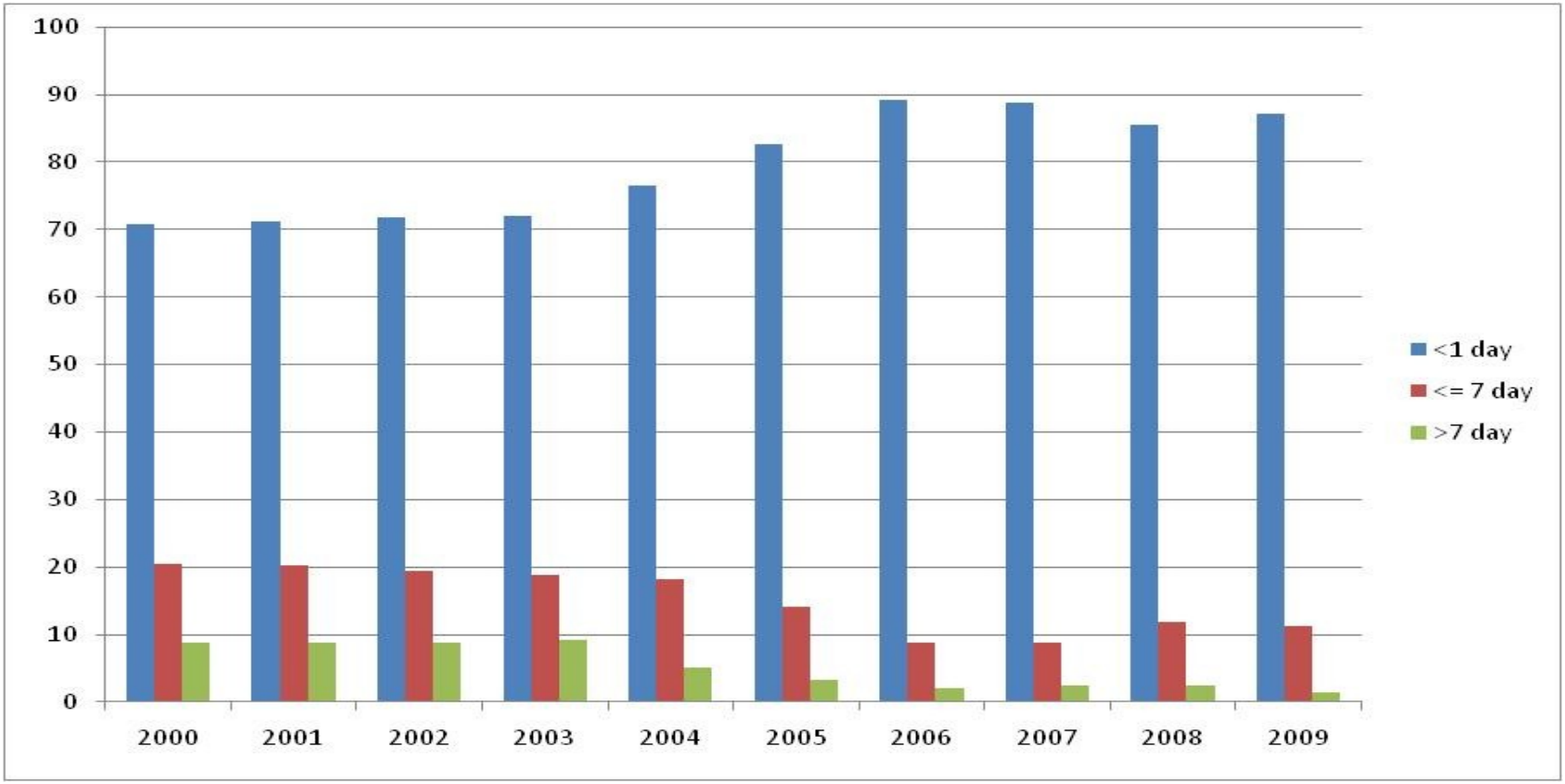
Design of „Quality Standard“ - guidelines

Common aim of the client, VAMED-KMB and in a facilitating role an external expert:

- Development and implementation of service level agreements (SLAs) as well as –
- Measurable standard for equipment conditions assessment and the presentation of results, based on actual practice and previously agreed definitions.
- Reliability standards based on the requirements of the hospital (opening hours and up-time requirements)
- Operation & service parameters - to be adhered to
- Permissible down time
- Permissible response time and time limits for rectification of deficiencies and repairs
- Regulations and Standard Operating Procedures for Ad Hoc and Periodic Maintenance (user information procedure, commencement and completion notification, agreement on affirmation of schedules, quality of training)

Duration of repair work, duration of rectification Statistics 2002-2009

Rectification within the following periods:



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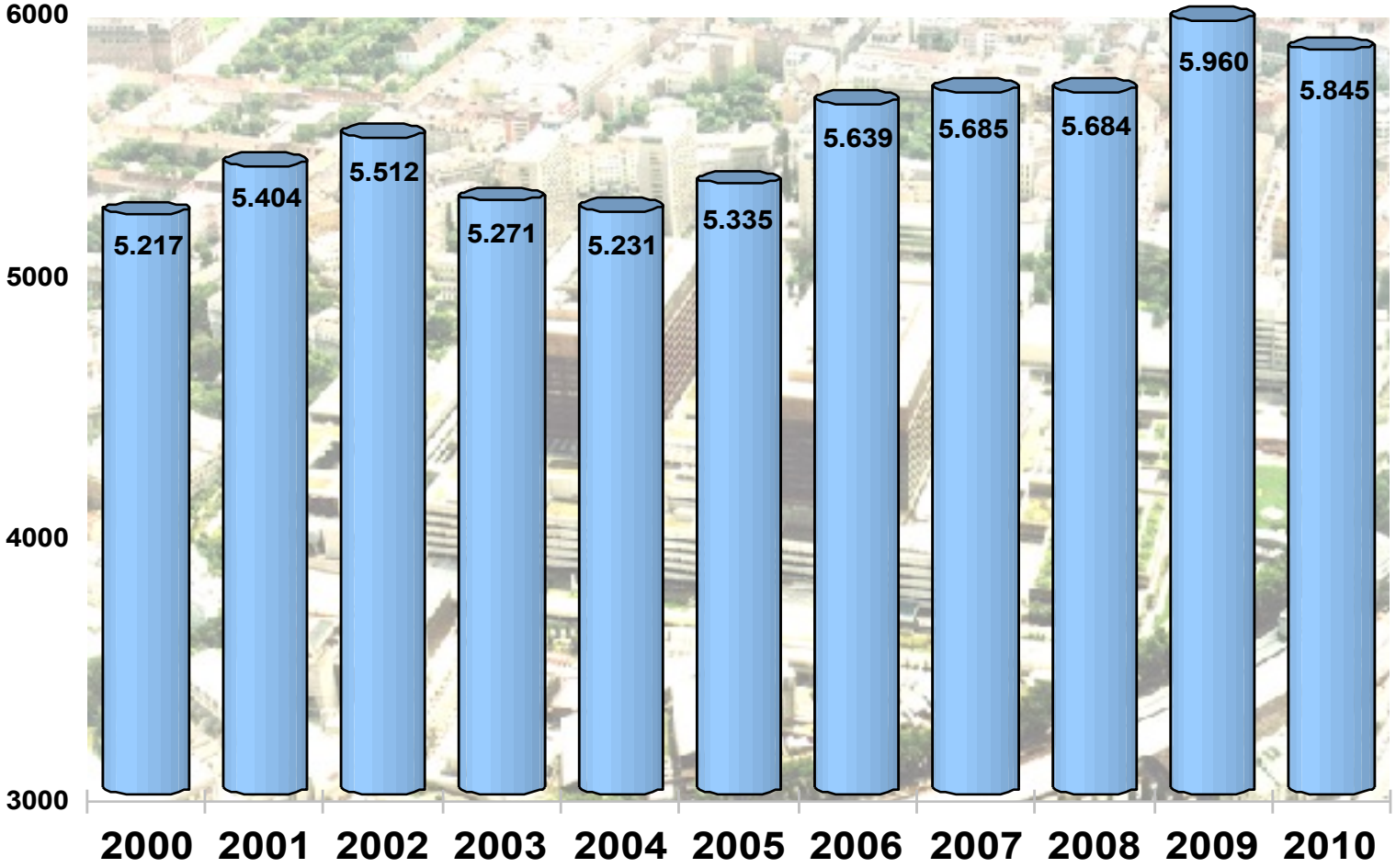
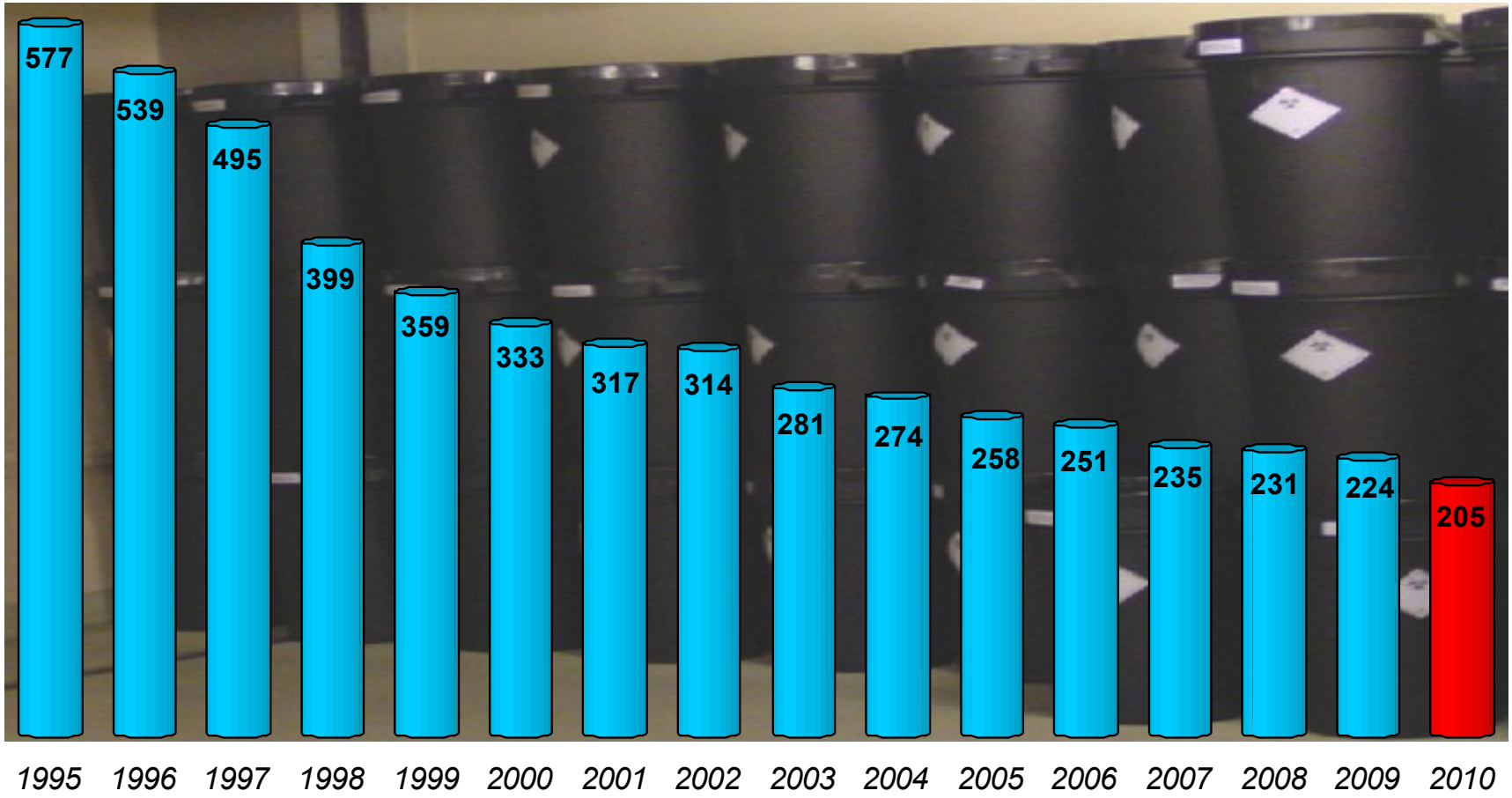
Vienna General Hospital
Development of total waste amounts 2000 – 2010 (in Tons)



Vienna General Hospital
Development of hazardous hospital waste amounts 1995 – 2010 (in Tons)

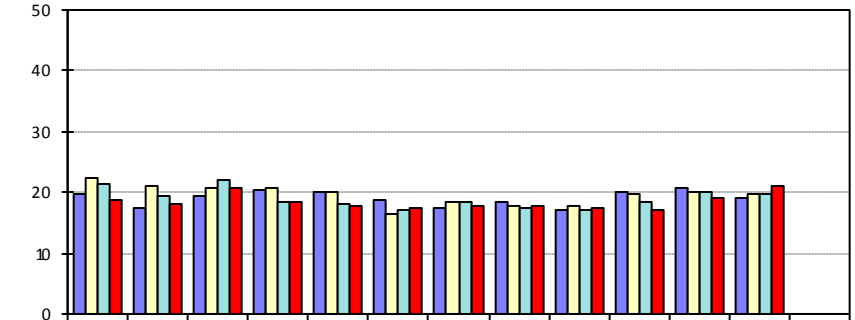


Energy and media monitoring

Sample building

Electrical

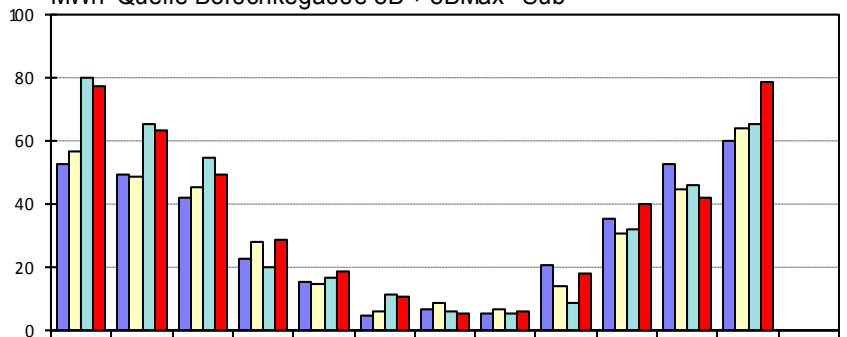
MWh Quelle CE001-P01



	Jan	Feb	Mar	Apr	Mai	Jun	Jul	Aug	Sep	Okt	Nov	Dez	JAHR
2007	20	18	19	21	20	19	18	18	17	20	21	19	229
2008	22	21	21	21	20	16	18	18	18	20	20	20	234
2009	21	19	22	18	18	17	18	17	17	18	20	20	227
2010	19	18	21	19	18	17	18	18	17	17	19	21	221

Heating

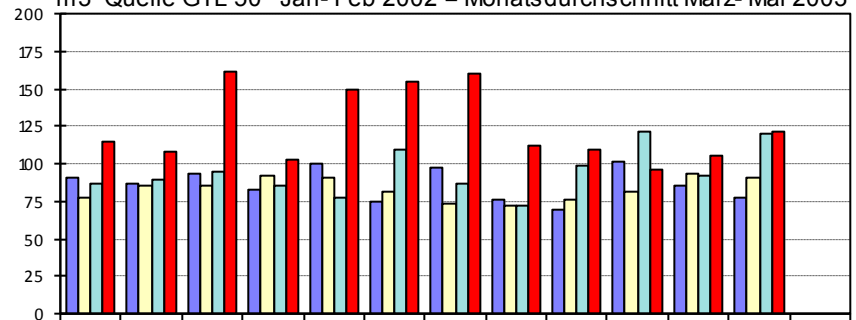
MWh Quelle Borschkegasse 8B + 8BMax - Sub



	Jan	Feb	Mar	Apr	Mai	Jun	Jul	Aug	Sep	Okt	Nov	Dez	JAHR
2007	53	49	42	23	15	5	6	6	20	36	53	60	366
2008	57	49	45	28	14	6	8	7	14	31	45	64	369
2009	80	65	54	20	16	11	6	5	9	32	46	66	411
2010	77	63	49	29	19	11	5	6	18	40	42	79	438

Potable water

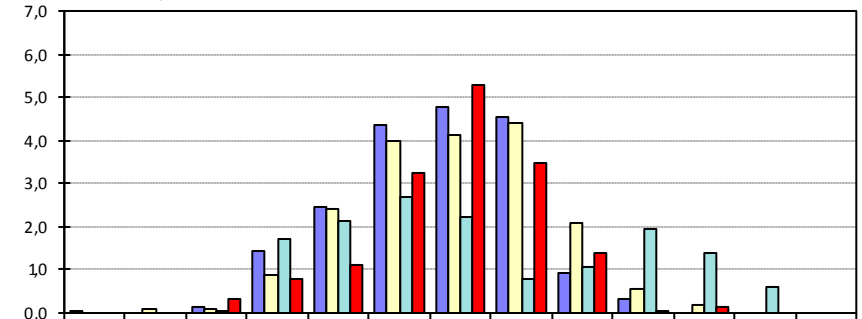
m3 Quelle GTL 50 Jan- Feb 2002 = Monatsdurchschnitt März- Mai 2003



	Jan	Feb	Mar	Apr	Mai	Jun	Jul	Aug	Sep	Okt	Nov	Dez	JAHR
2007	91	87	94	83	100	75	98	76	69	102	86	77	1.038
2008	77	86	86	92	91	82	73	72	76	82	94	91	1.002
2009	87	90	95	86	78	110	87	72	99	121	92	120	1.137
2010	115	108	162	103	150	155	160	112	109	96	105	122	1.497

Cooling

MWh Quelle: KKS50-Z51-002



	Jan	Feb	Mar	Apr	Mai	Jun	Jul	Aug	Sep	Okt	Nov	Dez	JAHR
2007	0,04	0,00	0,15	1,42	2,48	4,35	4,75	4,53	0,93	0,32	0,01	0,00	19,0
2008	0,00	0,10	0,09	0,87	2,43	3,99	4,12	4,39	2,11	0,57	0,16	0,00	18,8
2009	0,00	0,00	0,03	1,70	2,11	2,70	2,23	0,78	1,07	1,94	1,40	0,59	14,6
2010	0,00	0,00	0,33	0,77	1,11	3,23	5,27	3,50	1,41	0,05	0,15	0,00	15,8

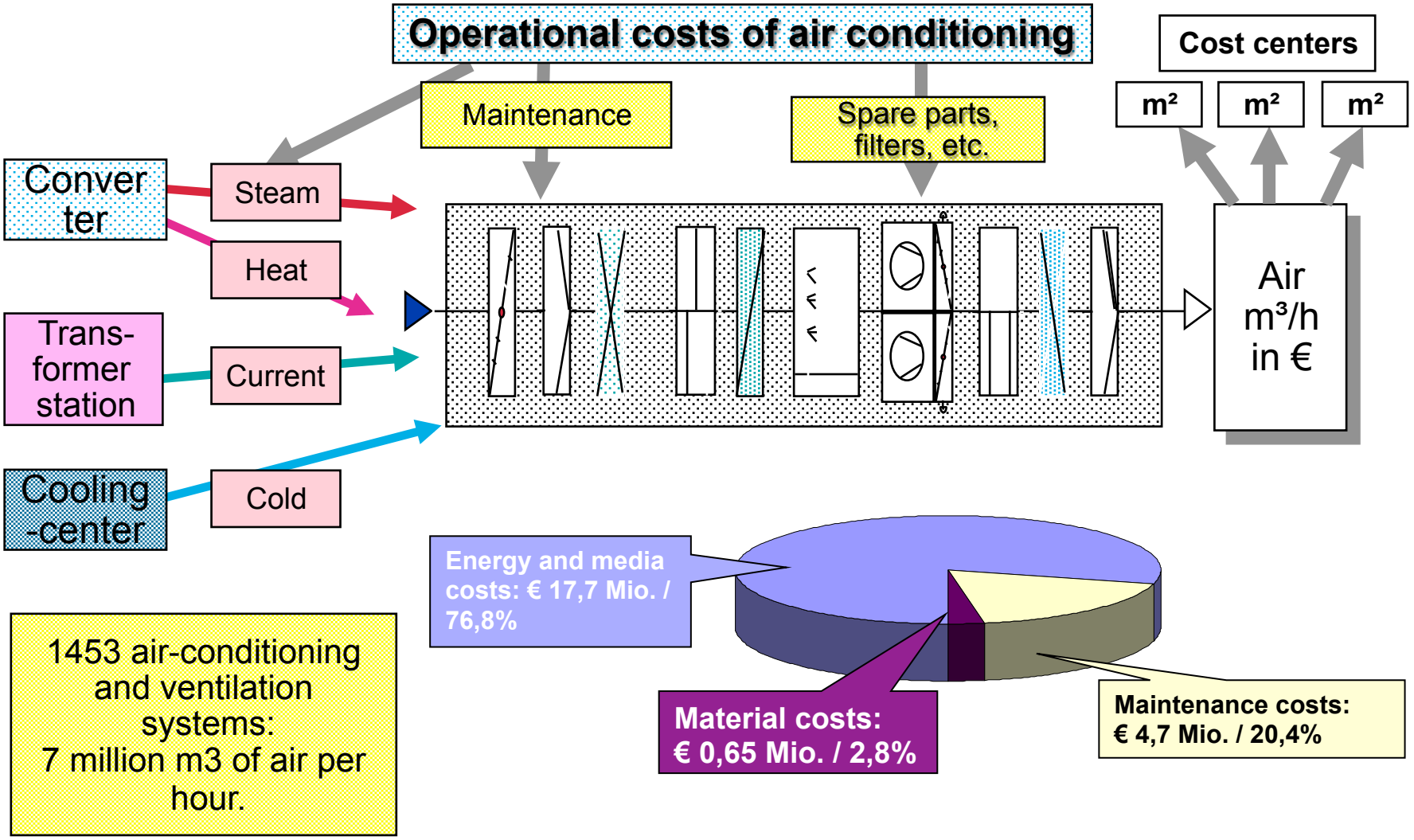
Energy and media monitoring

Benchmarking between buildings and building sections:

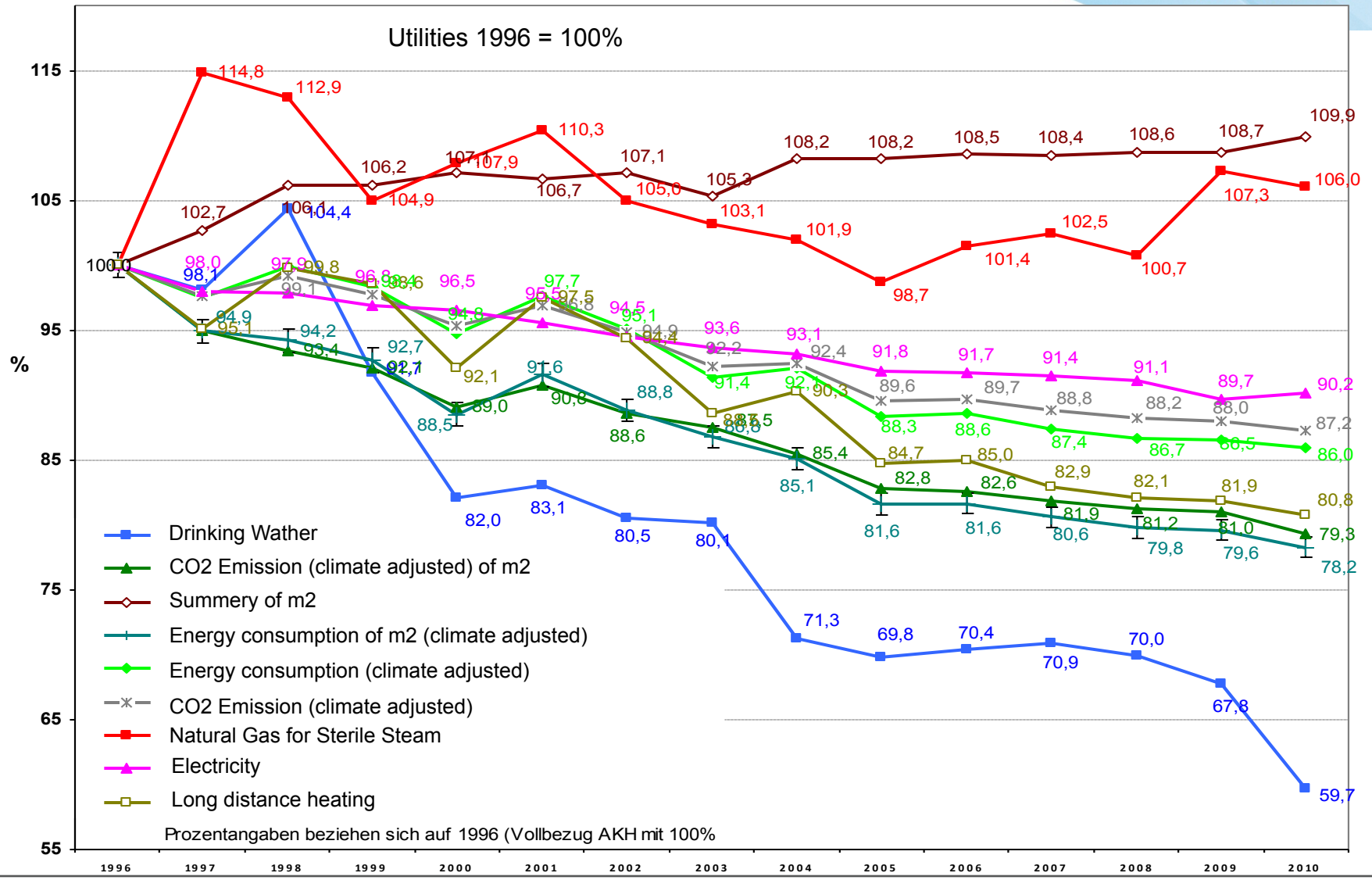
- Full air-conditioning (FAC), including humidification dehumidification
- Partial air-conditioning (PAC), heating, cooling
- Ventilation only (V)

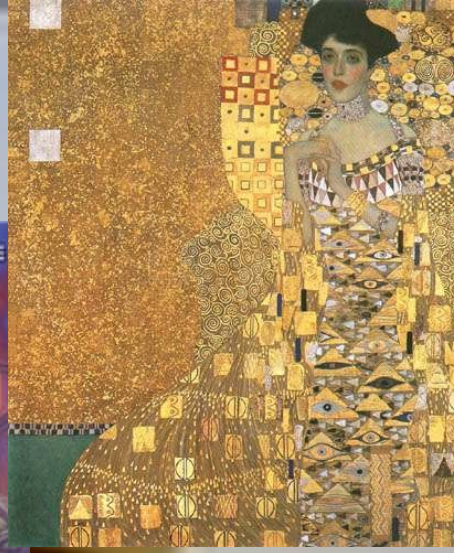
2008	Consumption and costs per year															
Bauteil	Units		pre-tax area	Electrical			Heating			Potable water			Cooling			
Nr.	Name		m²	MWh	kWh/m²		MWh	kWh/m²		m³	m³/m²		MWh	kWh/m²		
	Full air-conditioning				309,1			315,6			1,3			165,1		
	Partial air-conditioning				63,3			147,8			0,6			24,0		
	Ventilation only				34,6			94,1			0,3			8,6		

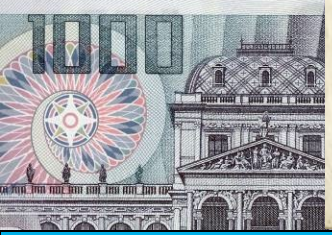
Cost of air conditioning



Energy and media monitoring







Thank you

It was a pleasure to be here with you