OSIsoft®

REGIONAL SEMINAR 2012

EMEA

The Power of Data

Requirements & Benefits of an **Energy Management System** in the Chemical Industry

Presented by **Dr. Gerhard Then**

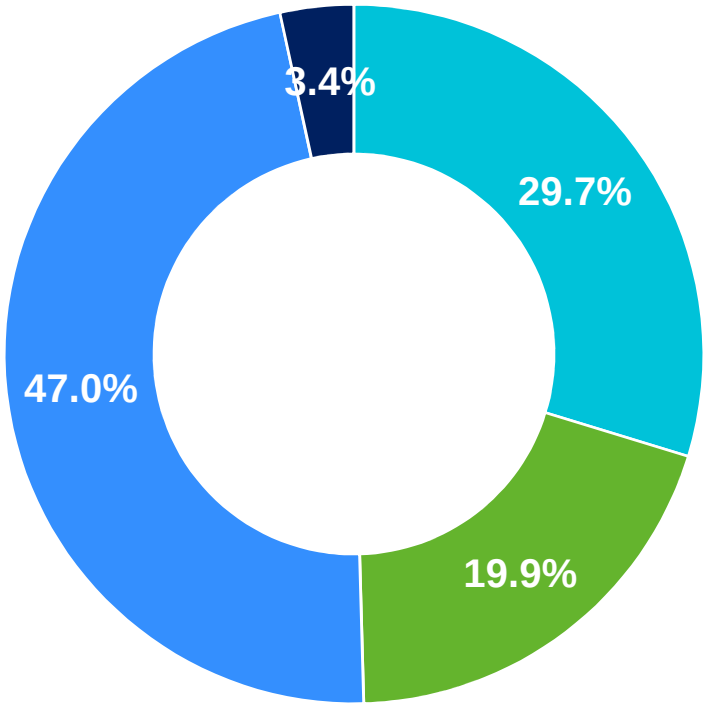
Abstract

- Energy performance in the chemical industry has a long history and much has been achieved over the last 20 years. However there is still enough potential in reducing the specific energy intensity of chemical production processes. We describe an Energy Efficiency Management System which is applicable to all asset intense industry.
- This system links the current energy consumption to the energy optimum of the existing process and finally to the theoretical energy optimum. It is a real energy management system from shop floor to board and the only system commercially available having the vision what is achievable by aiming for the theoretical energy optimum.
- This System has been developed by Bayer MaterialScience and is being introduced in more than 60 of our most energy intense units globally. The data collection and processing on a central server will be explained. By end of 2011 we have achieved about 200 000 tons of CO2 reductions, 600 GWh energy (electricity steam and natural gas) savings and more than € 35 million through increasing the energy performance of our processes.
- Detailed technical examples will be given. With this system Bayer MaterialScience achieved the DIN 16001 certification.

Agenda

- Key Figures Bayer and Bayer MaterialScience
- Requirements of an Energy Efficiency Management System
- STRUCTese™ – an Energy Management System
- Examples
- Summary

Bayer – A leader in its markets



Sales 2011: **€36.5bn**

HealthCare (BHC)
Pharmaceuticals,
leading positions in key categories Consumer Health, OTC products, blood glucose meters and veterinary medicines, global **#2-4**

CropScience (BCS)
Agrochemicals and seeds & traits, global #**2** in agrochemicals

MaterialScience (BMS)
Polyurethanes and polycarbonates, global **#1 or 2**

Corporate Center, Service Companies

Bayer MaterialScience links oil and petro-chemicals to key consumer markets

Petro-chemicals
i.e. benzene, toluene, phenol, acetone, …

Other input
i.e. salt, energy,…

- Automotive / Transport
- Electrical / Electronics / IT
- Construction
- Furniture / Wood
- Chemicals

BMS' core products and solutions
i.e. polyurethane rigid (MDI) and flexible foams (TDI), polycarbonate (PCS) granules, sheets and films, raw materials for coatings and adhesives (CAS), ….

Bayer MaterialScience Key Data 2011

Bayer MaterialScience provides high-tech polymer solutions:

- 14,800 employees worldwide
- annual sales of € 10.8 billion
- R&D budget € 237 million (excl. shared developments with customers). More than 1,000 employees were involved in research and development projects.

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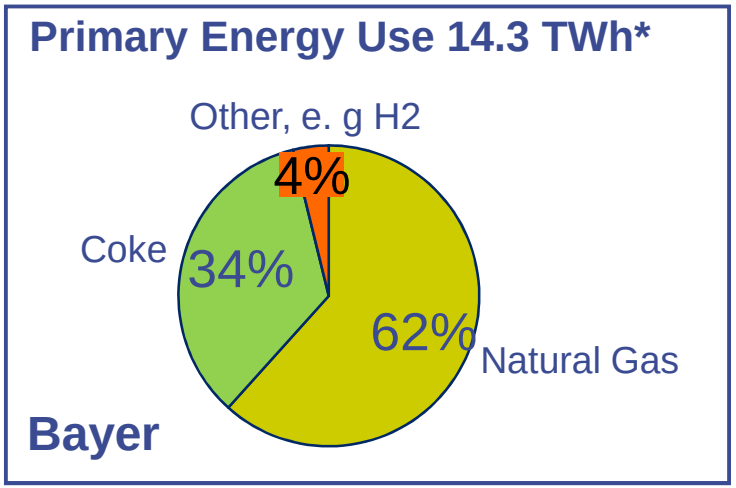
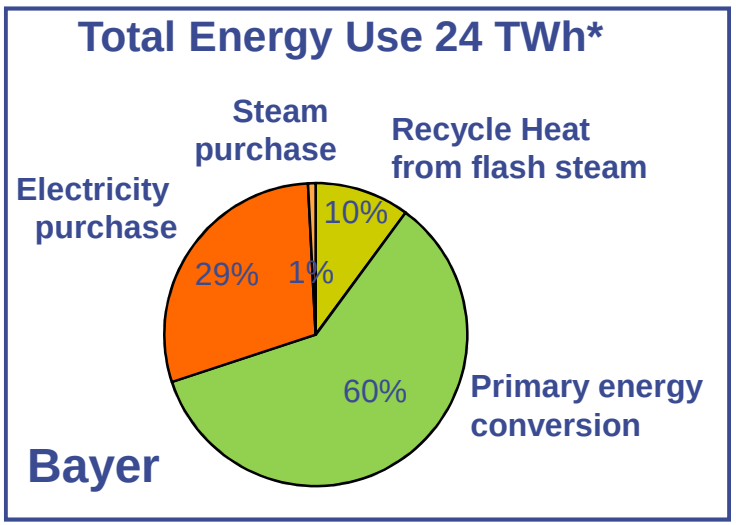
Bayer‘s annual energy use is ~ 24 TWh, 2/3 of it at BMS





BMS

- BMS has reduced its direct and indirect GHG emissions by 37% between 1990 and 2007
- Annual R&D budget € 85 Million improving climate relevant production technologies and products
- BMS has invested € 620 Million in in optimized technologies and Infrastructure between 2008 and 2010
- Most of the electricity and steam is co-generated in highly efficient CHP unit and waste incineration is utilized

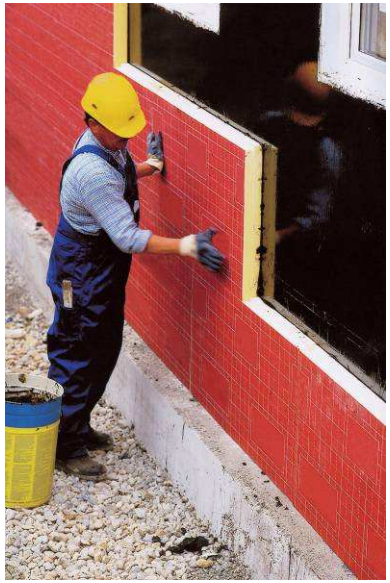
* Source: Bayer Sustainability Report 2010

Energy management is key to sustainable savings

Three Dimensions of Energy Savings

Technology

- Gas phase phosgenation
- Oxygen Depletion Cathode
- Combined Heat and Power



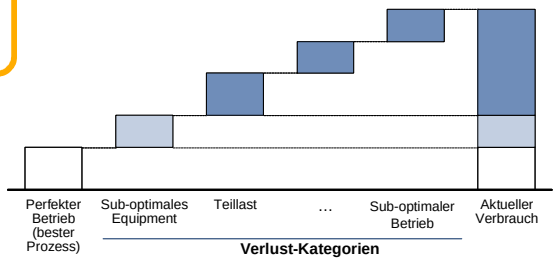
Energy-Efficiency

Solutions

- EcoCommercial Building
- Light Materials
- Insulations*

Management

- Monitoring
- Reporting
- Benchmarking



* PUR insulation saves 60x the energy used to produce it

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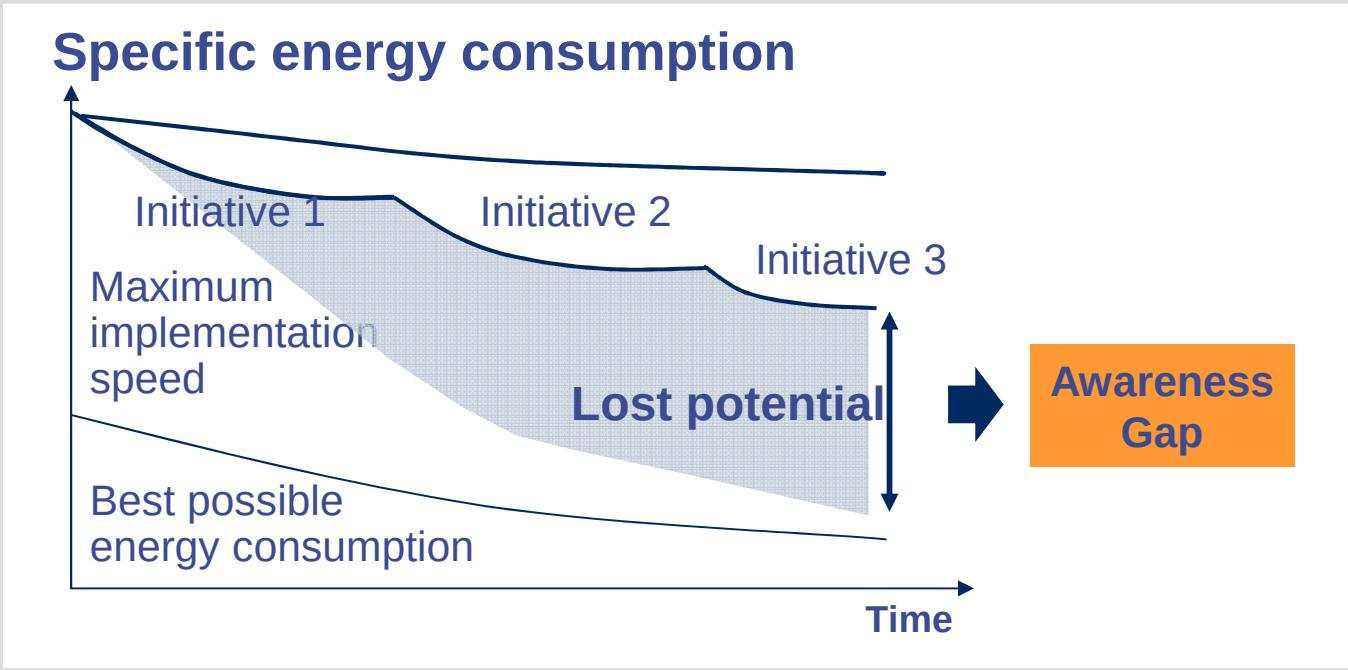
Closing the awareness gap is a challenge for chemical companies



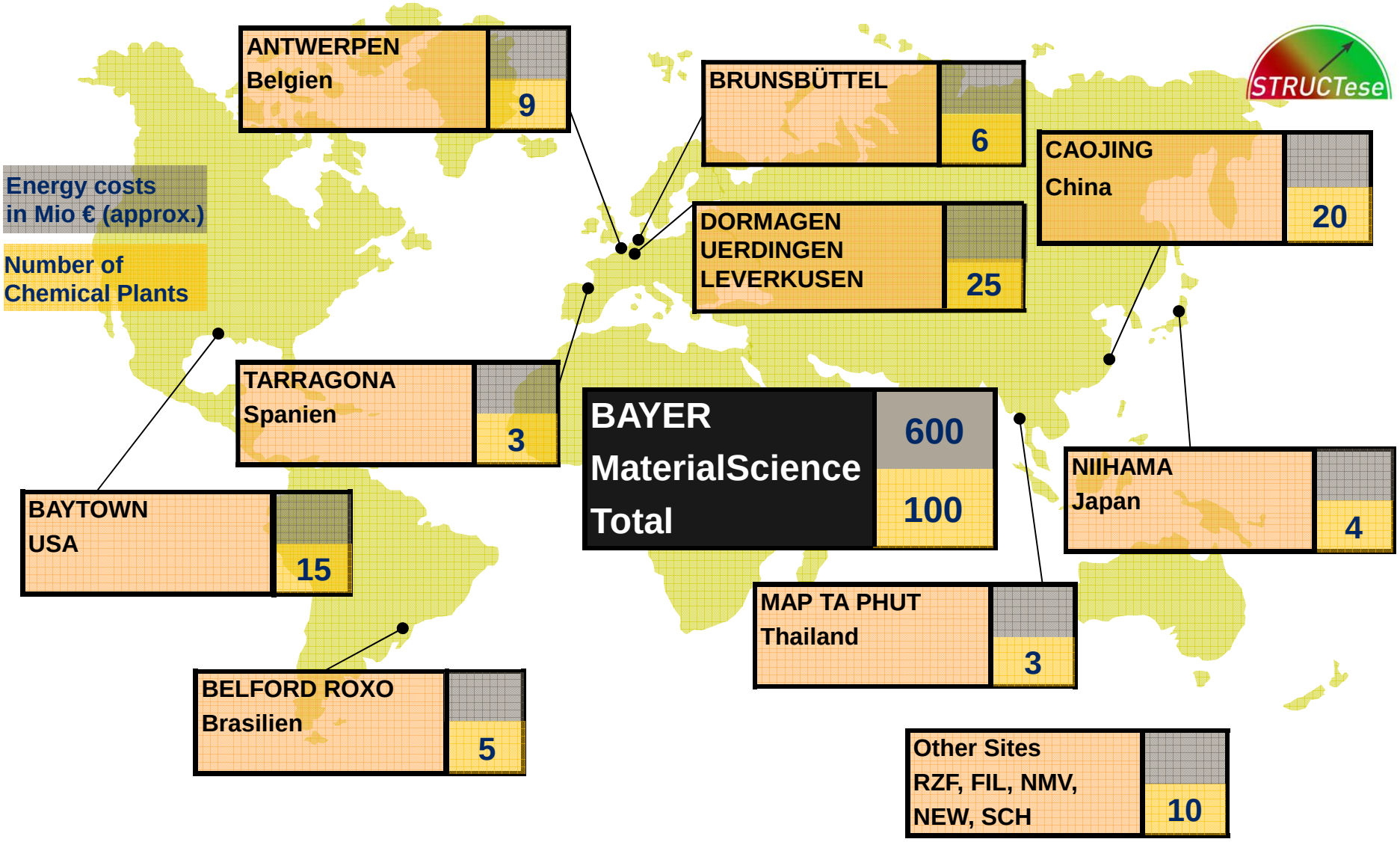
- **Individual energy savings initiatives cannot sustain high awareness level over time**
- **Total savings fall short of maximum potential, past lapses cannot be compensated for**

Implement an Energy Efficiency Management system

Goal

Increase the energy performance by at least 10% in about 70 chemical production units by implementing a sustainable **Energy Efficiency Management System** (as opposed to only energy monitoring and some graphical output)

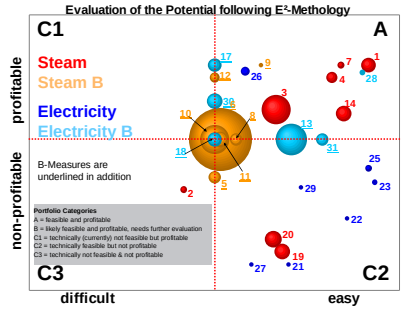
How do you build a global, sustainable BMS Energy Management System ?



STRUCTese™ applies a three step approach to realize energy saving and energy conscious behavior

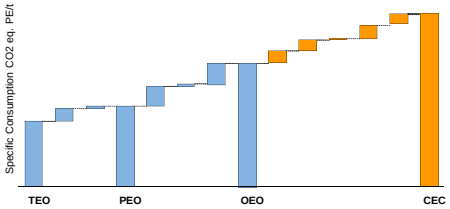
1 Energy-Efficiency Check & Improvement Plan

- Identification of saving potential
- Categorization of measures
- Implementation of measures



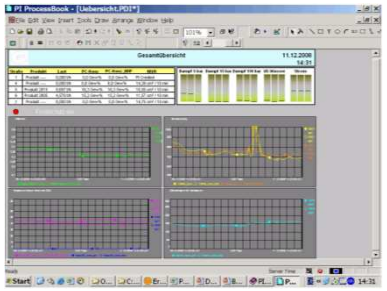
2 Energy Loss Cascade & Performance Indicators

- Visualization of energy losses
- Reporting of losses and reasons
- Target setting



3 Online Monitoring & Daily Energy Protocol

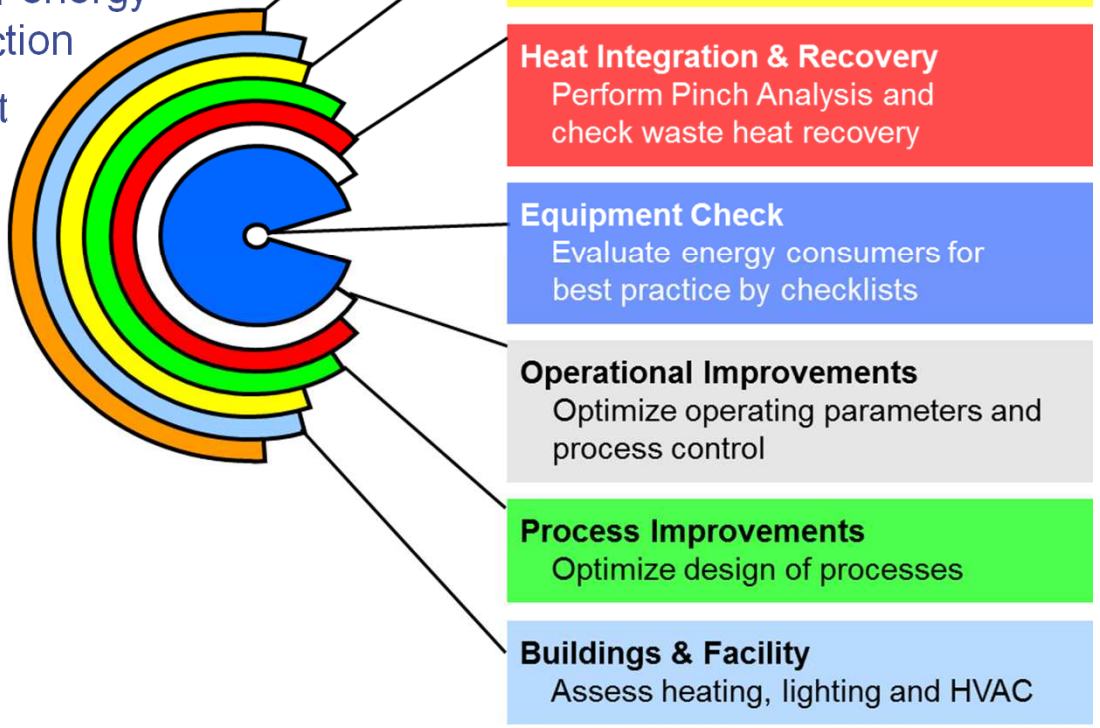
- Visualization of BDP deviations
- Energy optimal operation
- Implementation of awareness



The Energy Efficiency Check considers a wide range of optimization opportunities

Energy Efficiency Check

- is a systematic screening
- identifies measures for energy & CO_2 emission reduction
- results in improvement suggestions

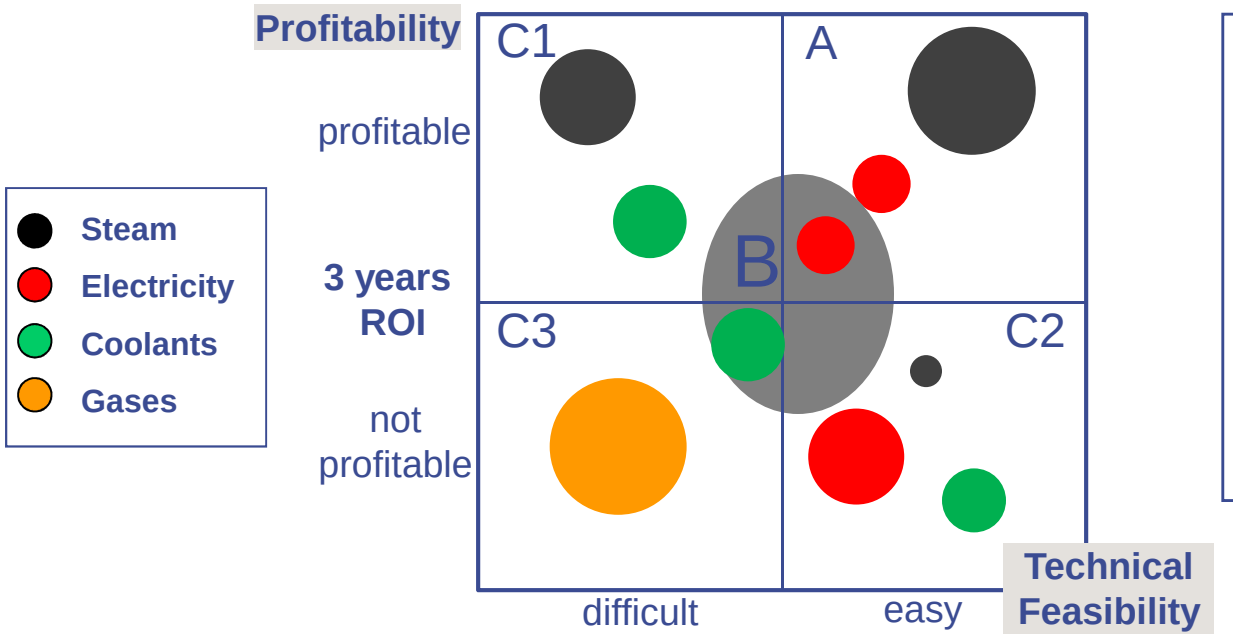


All improvement ideas are evaluated and prioritized

All improvement ideas are evaluated with regard to

- Technical feasibility
- Savings potential (CO2e and costs)
- Costs for implementation (rough estimate)
- Profitability (rough estimate)

and displayed in a portfolio:



Categories

A = feasible and profitable

B = likely feasible and profitable, needs further evaluation

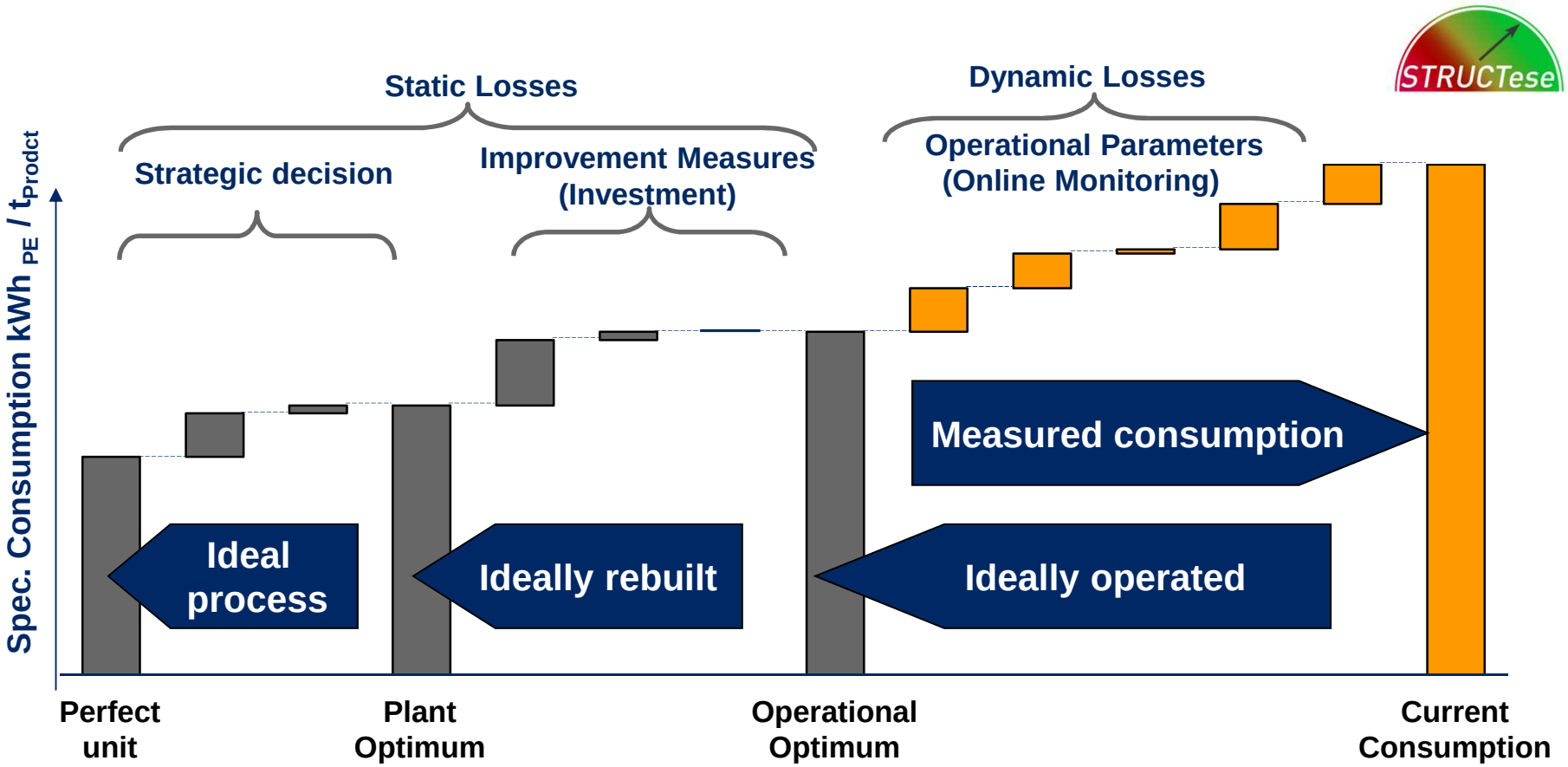
C1 = technically difficult but profitable

C2 = technically feasible but not profitable

C3 = technically difficult & not profitable

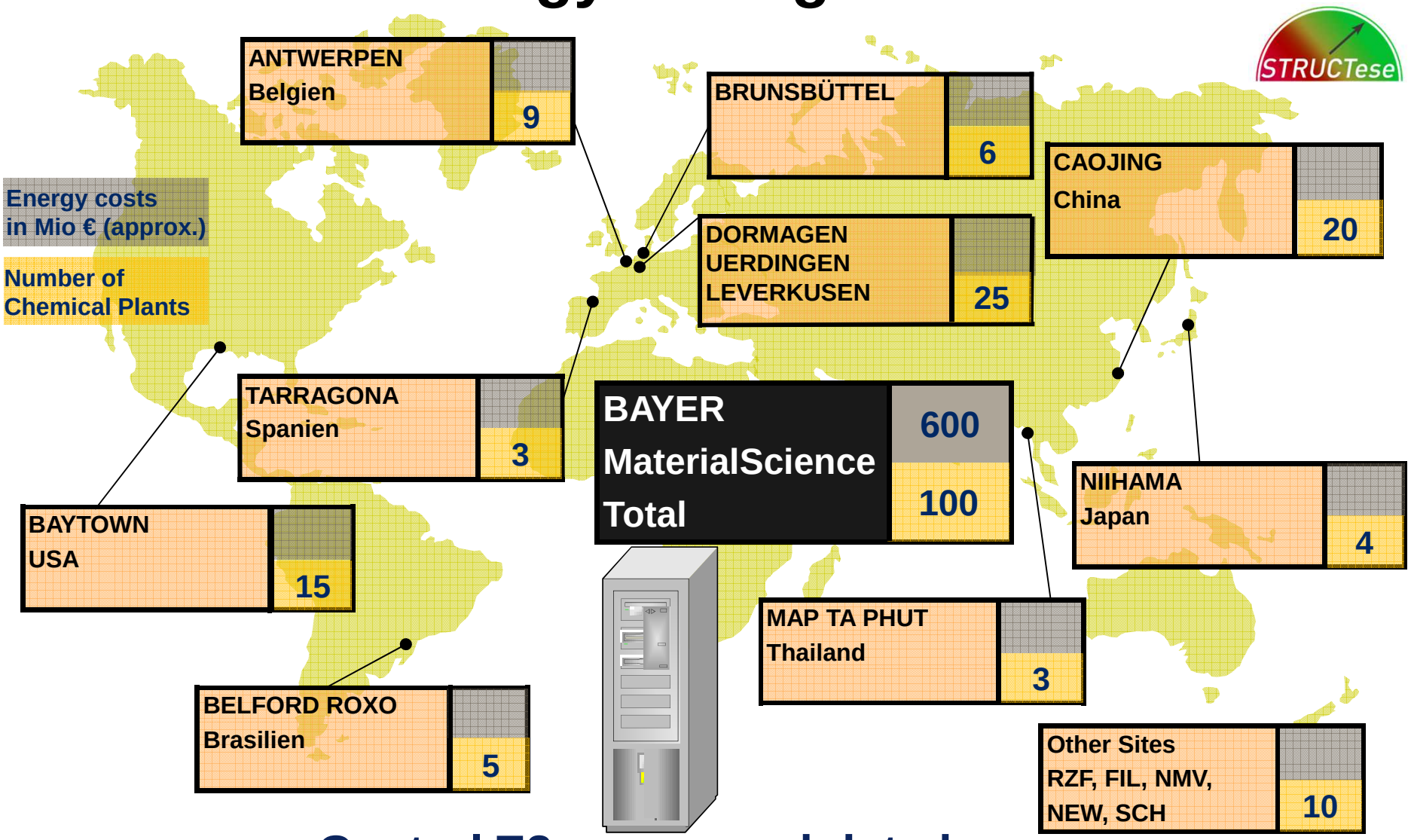
Bubble Size = Savings Potential

STRUCTese™ Energy-Loss Cascade links current energy consumption to the true minimum



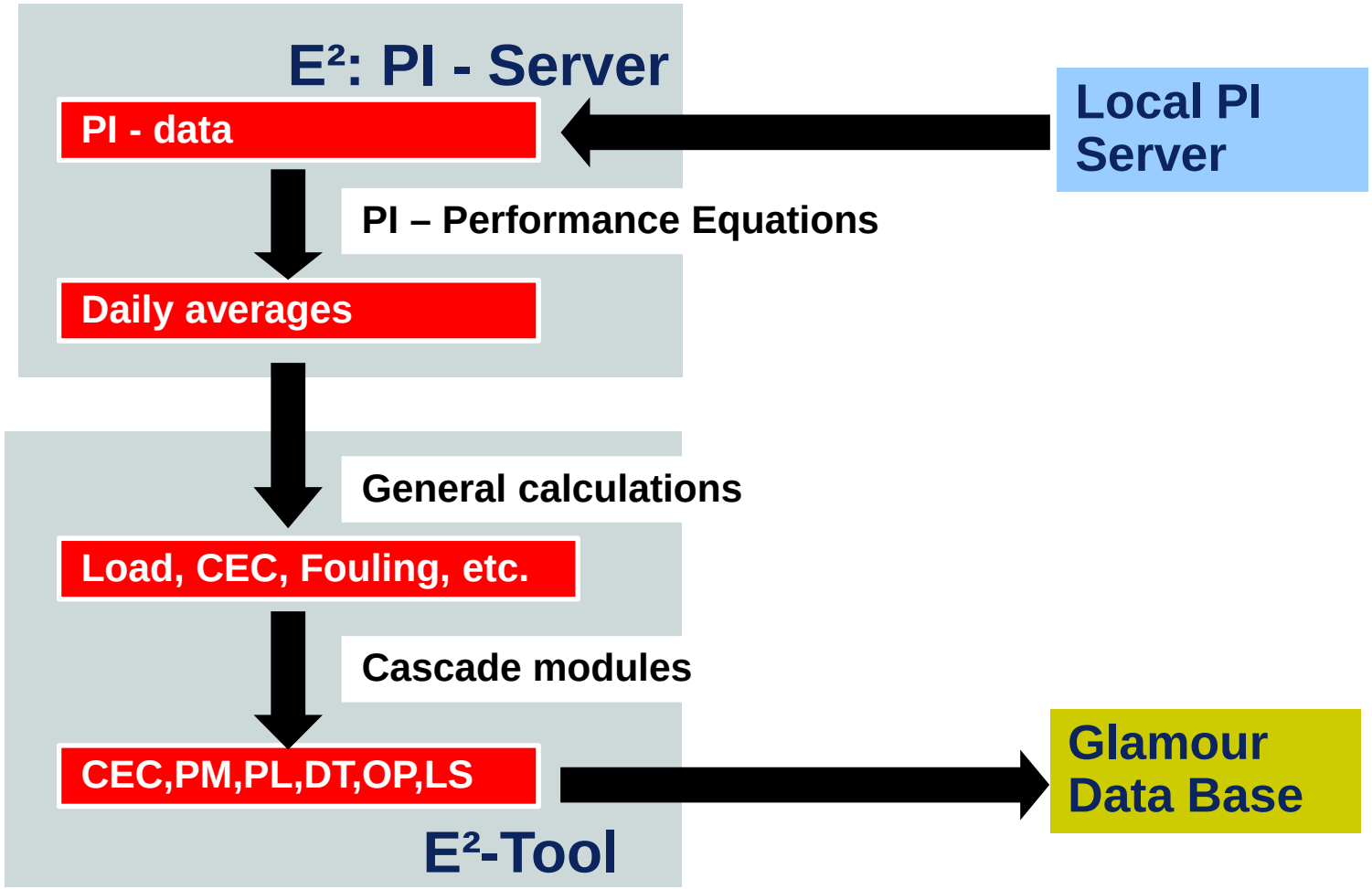
- In total 10 different energy loss categories
- (Monthly) calculation creates transparency for operations and management
- Loss cascade demystifies energy consumption

Global BMS Energy Management



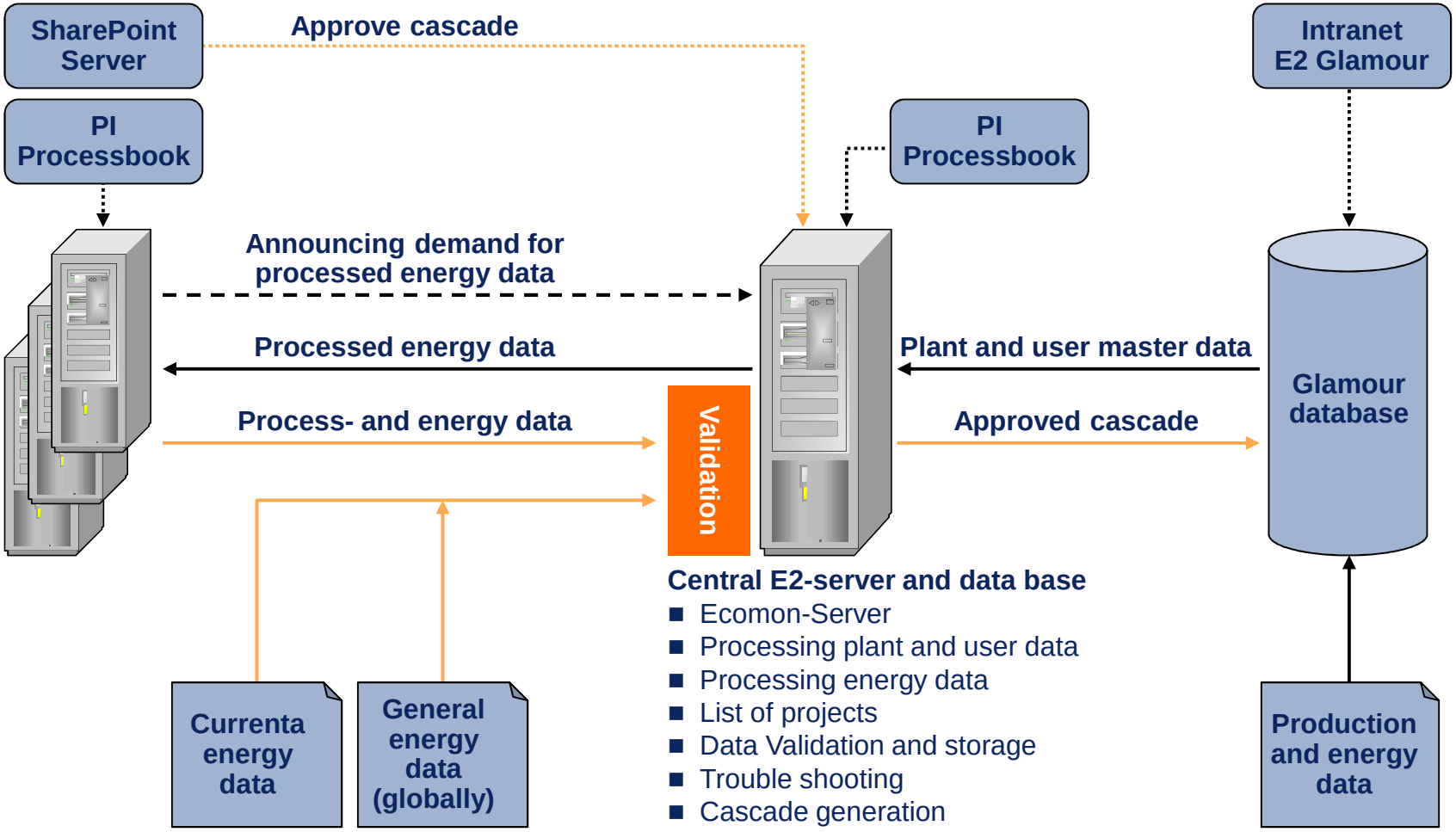
Central E2-server and data base

A 3-stage server architecture guarantees globally consistent data and models

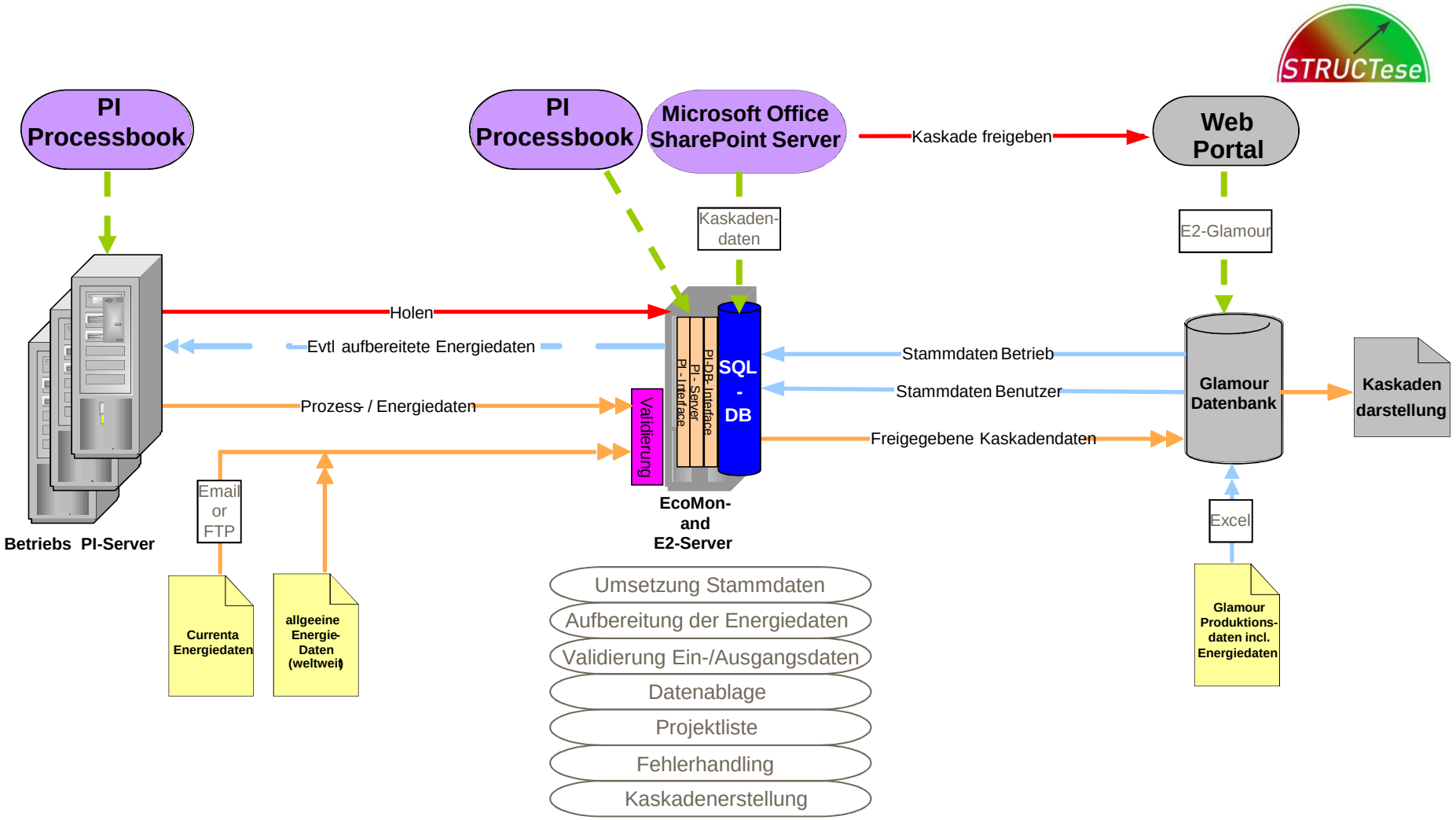


Global data are collected on a central server

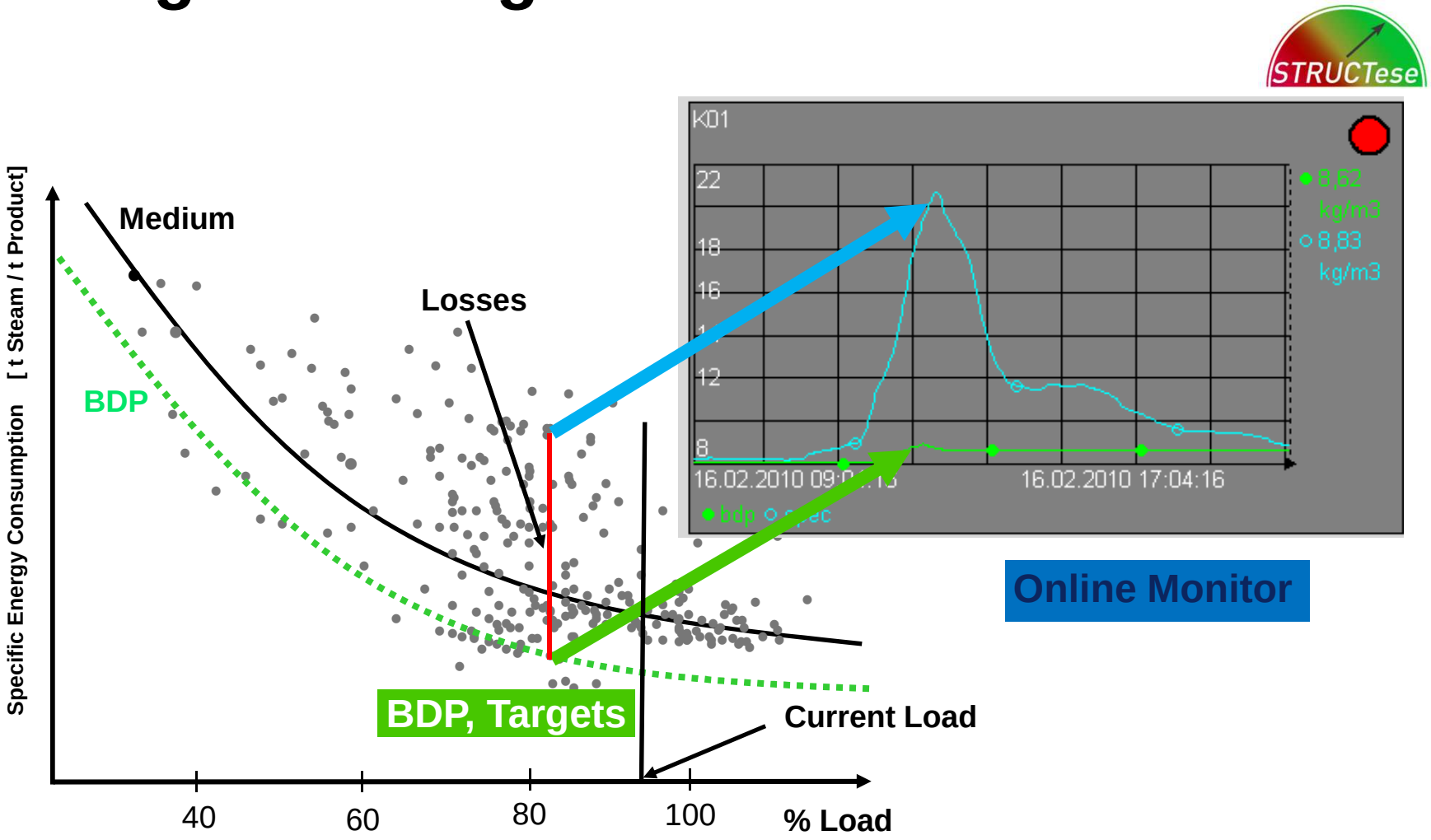
- E² data and process flow



Modular concept and functional structure



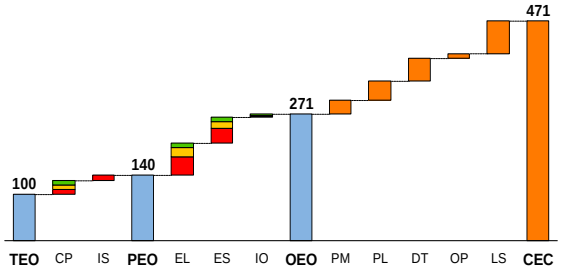
Better understanding of plant performance through trending with PI Processbook

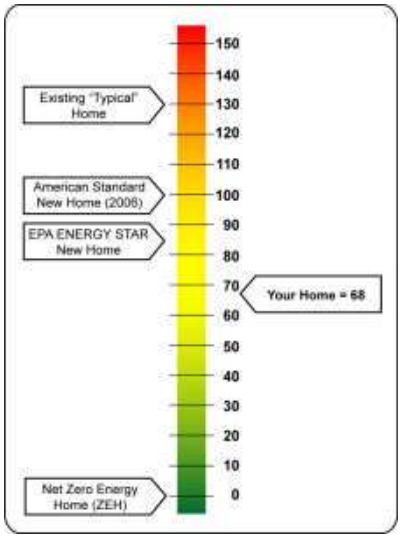


The Energy Cascade as a management tool can be used for target setting and benchmarking

Objective:

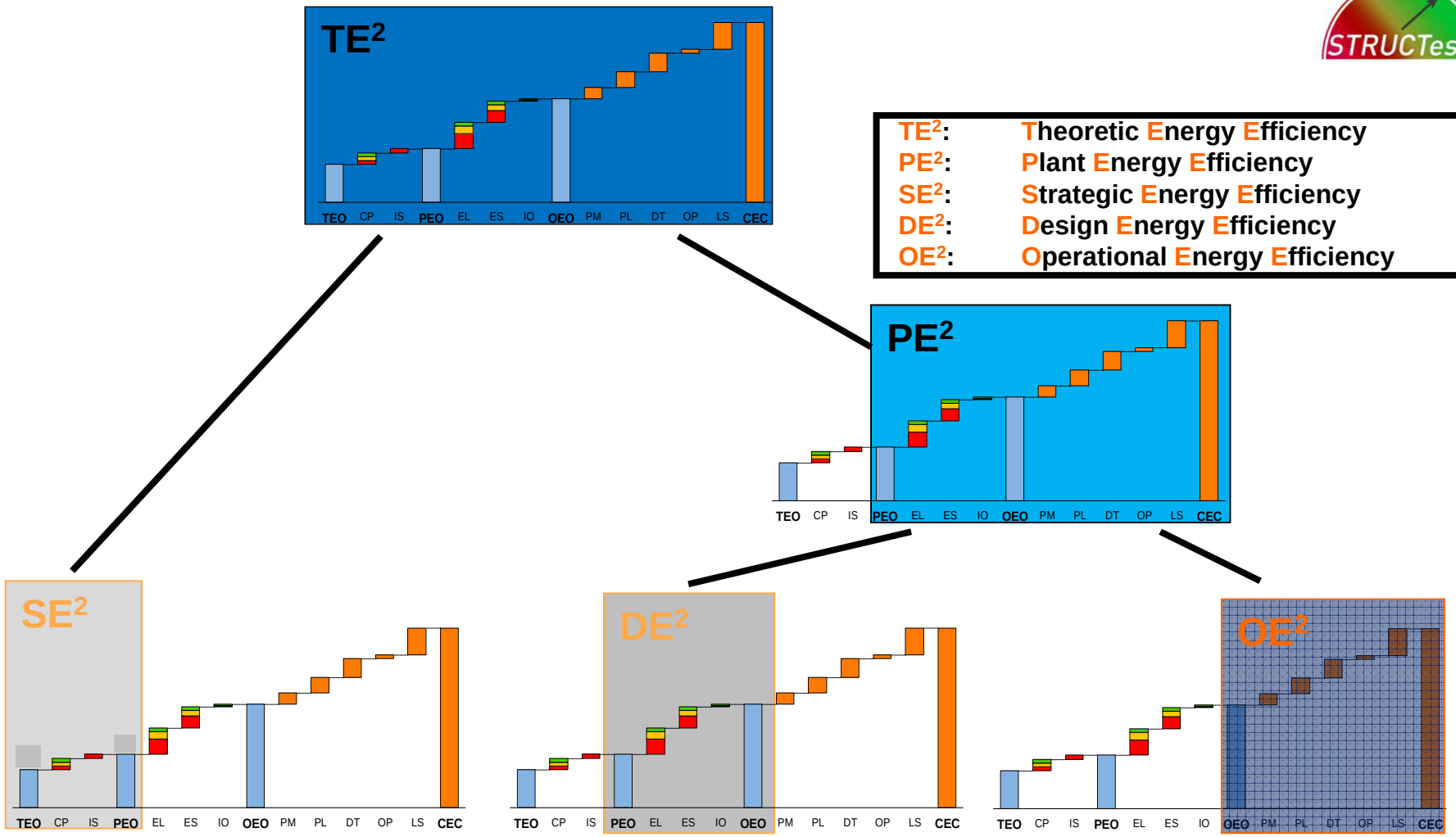
develop energy-efficiency-performance indicators





- Enable meaningful target setting for improvement of energy-efficiency at all organizational levels
- Enable energy-efficiency benchmarking for different technologies (companies?)

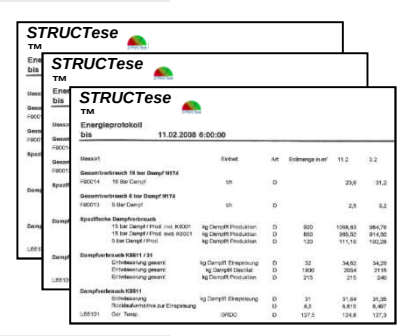
Performance Indicators are designed to focus on different management tasks



Loss Cascade is complemented by Daily Energy Protocol and Online Monitoring

Daily Energy Protocol

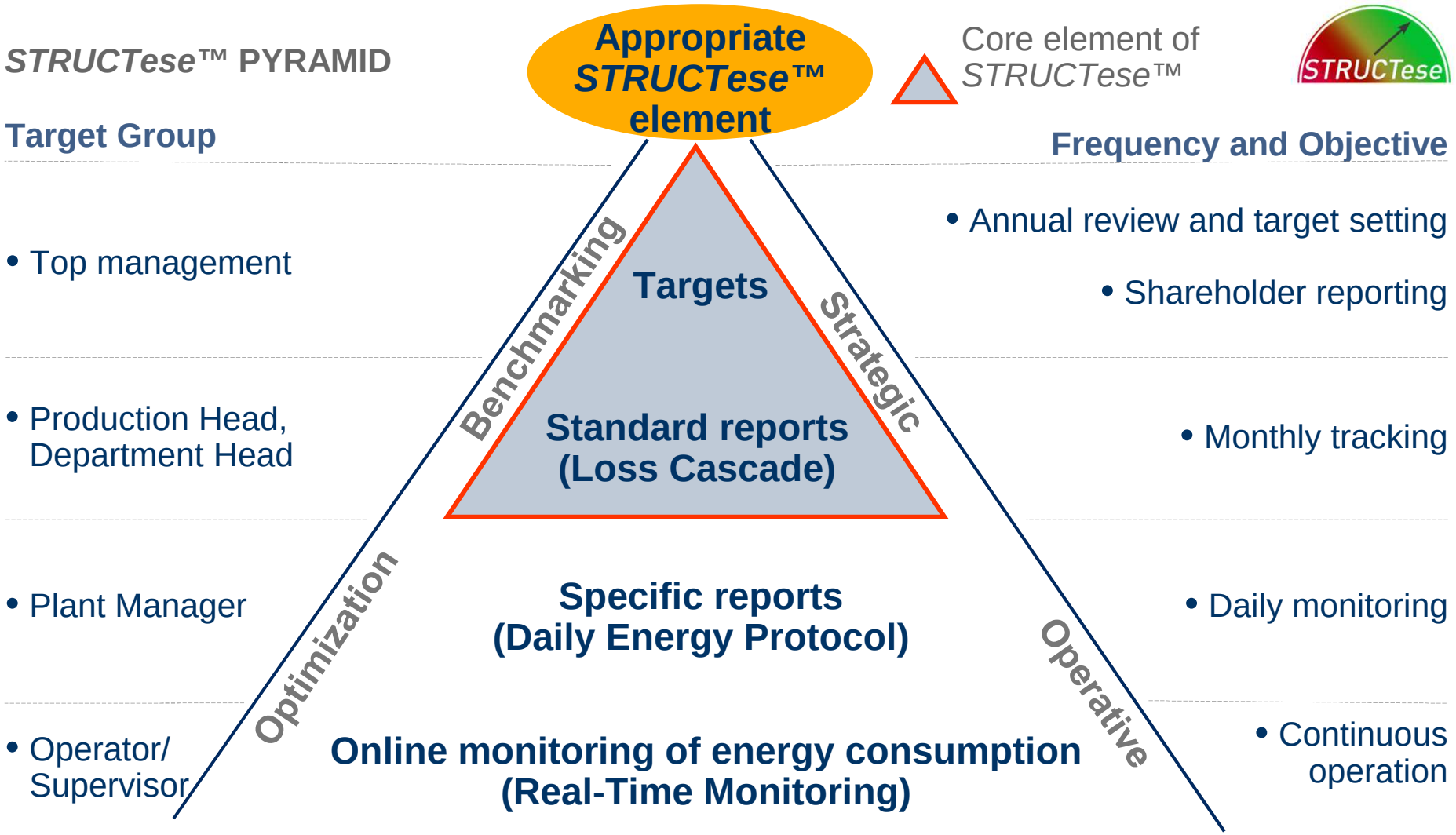
- Shows 24-hour average energy consumption of selected equipment compared with target level
- Unit supervision's tool to push for improvements in every morning meeting
- Example (plant A): daily use over two years led to 15% energy reduction without any investments



Online Monitoring

- Shows online energy consumption of selected equipment against best demonstrated practice consumption
- Operator's tool to influence energy usage
- Example (plant B): operation of energy efficient processes led to 12% energy reduction within two months without any investments

STRUCTese™ is an integrated energy management system with tools for all levels of the organization



BMS is certified having implemented the Energy Management System STRUCTese™

CERTIFICATE

DQS GmbH
Deutsche Gesellschaft zur Zertifizierung von Managementsystemen

hereby certifies that the company

Bayer MaterialScience

Bayer MaterialScience AG
51368 Leverkusen
Germany

with the Business Units Polycarbonates, Polyurethanes, Coatings / Adhesives / Specialties, the Industrial Operation (IO) Basic Chemicals
the Production sites / affiliates as listed in the annex

has implemented and maintains an **energy management system** internal name STRUCTese.

Scope:
Development, manufacturing, application technology, technical service of Polycarbonates, Polyurethanes, Coatings / Adhesives / Specialties and Basic Chemicals

Through an audit, documented in a report, it was verified that the management system fulfills the requirements of the following standard:

EN 16001 : 2009

Certificate registration no.	267791 EN16
Date of certification	2010-06-07
Valid until	2013-06-06

Michael Drechsel
Managing Director

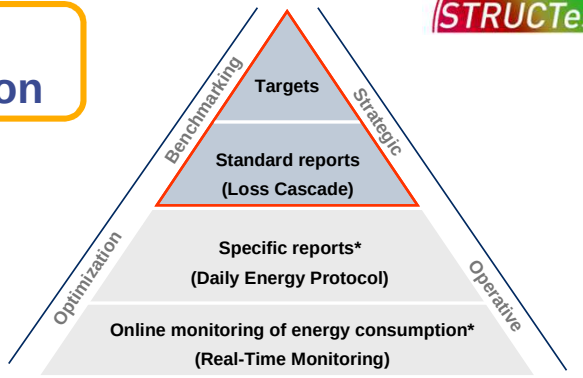
Jan Böge
Managing Director

- STRUCTese™ is the sole commercial EMS, linking the current energy consumption to the theoretical optimum
- STRUTese™ shows the way to the true potential

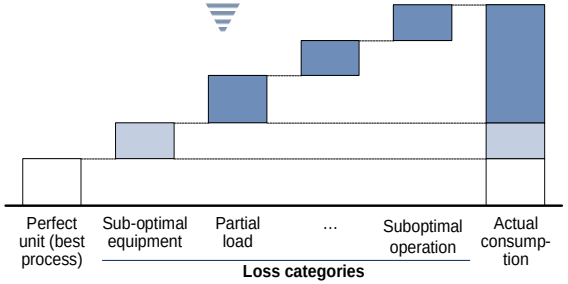
STRUCTese™® methodology enables the management to define the track ahead

BMS target for specific CO2 reduction until 2020 is 40%.

The rear view mirror confirms your position



Top-Down / Bottom-Up Target Setting



The energy cascades leads the path to go

Source: Web presence of view.stern.de-Fotocommunity and thinkware (www.itechnews.net)

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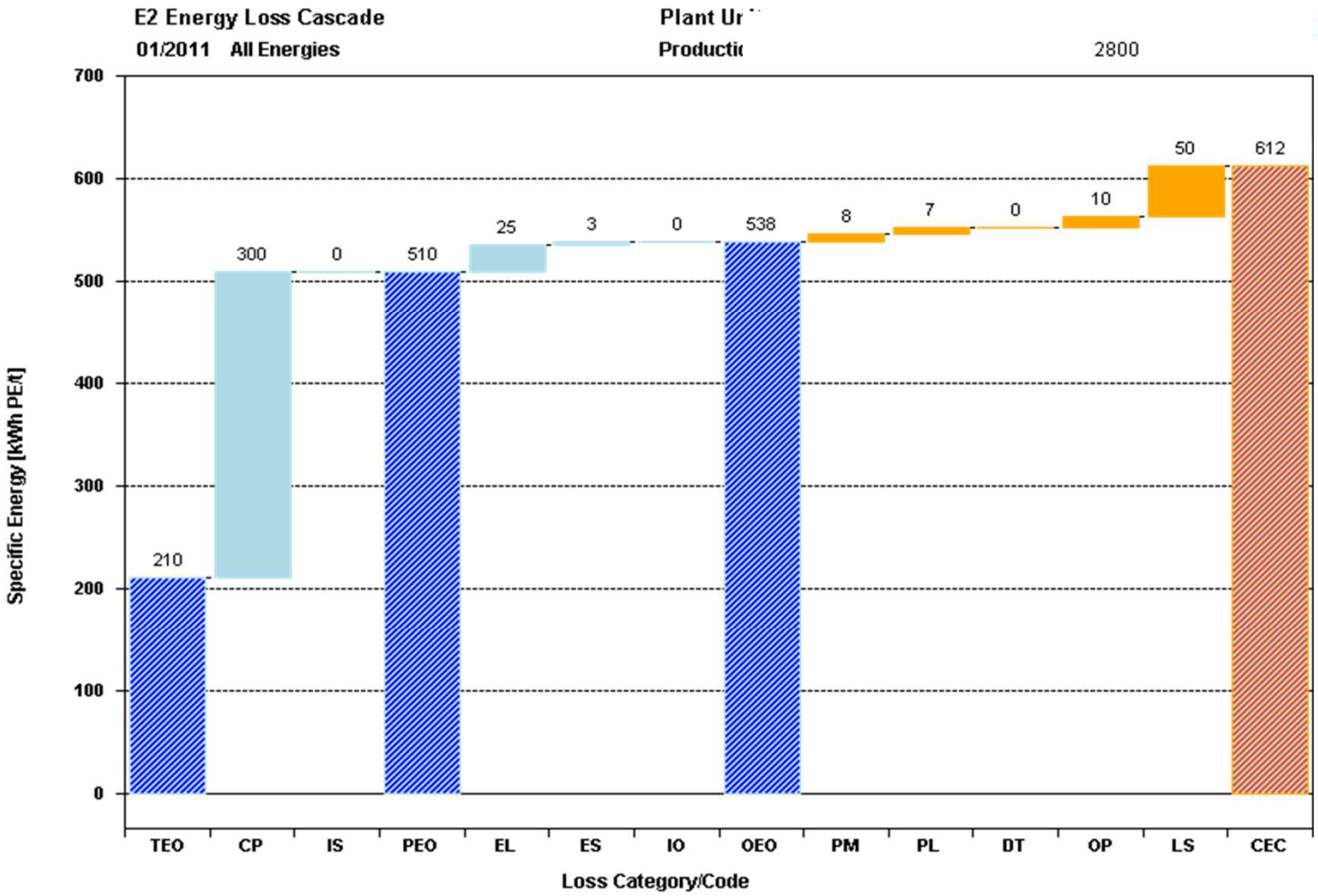
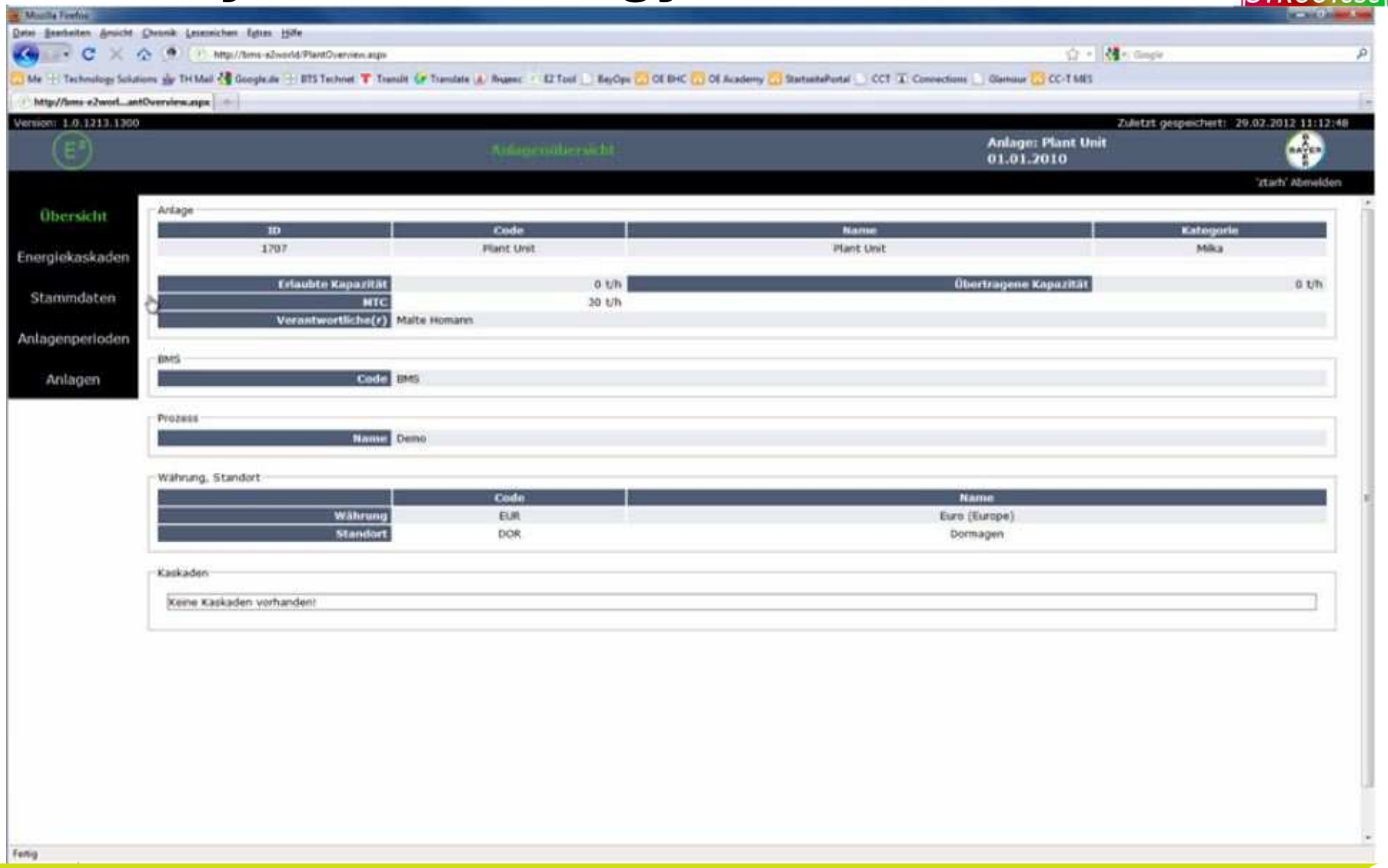
Energy Loss Cascade Software



Software was developed with MEGLA GmbH and Bayer Technology Services



Chlorine Production: Taking out 30% of energy

ODC* technology revolutionizes chlorine production by hydrochloric acid electrolysis

Advantages:

- 30 % less electrical energy
- Closed chlorine recycling during isocyanate production

Annual capacity:

- in Germany: 20,000 t chlorine
- in China: 215,000 t chlorine

Annual CO2 reduction: 250,000t

* Oxygen depletion cathode

TDI Production:
Taking out energy and reducing emissions

Gas-phase phosgenation for TDI production based on the principle of the fuel cell

Advantages:

- 80 % less solvent
- Up to 60 % less energy
- 60,000 tons fewer CO2 emissions per world-scale plant of same size (250,000 t p.a.)
- 20 % lower investment costs

Annual capacity:

- China: 250,000 t TDI in 2011
- Europe: 300,000 t TDI in 2014

Annual CO2e Reduction: 250 000 t

Nitric Acid Production: NOx emissions close to zero

- Nitric Acid production volume in Dormagen is 580 000 t/y
- NOx emissions reduced by 98 – 99% with EnviNOx® catalysis
- Reduction of 220.000 tons CO2e
- Corresponding to 100.000 cars with a 15 000 km p.a.

Buildings:
Toward zero emissions

EcoCommercial building

- Rigid polyurethane foam for high- and low-temperature insulation
- Lightweight, stable and transparent polycarbonate sheets
- Components for durable, efficient photovoltaics
- Raw materials for low- and zero-VOC paints, coatings and adhesives
- Building a network of specialists
- 3 buildings: Dormagen (Germany), Pittsburgh (USA) and Greater Noida (India)

Communication activities strengthen the awareness for energy efficiency

E² poster campaign

- The central theme is energy efficiency and **how employees can contribute**
- The posters inform about the BMS energy policy, climate goals, and the energy management system E²
- **5 different motives** to be published one after the other, every 3 months
- The posters will be published at **all German sites** in both, plants and offices

A web based training was developed for all BMS AG employees.

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Designed to Sustain Energy Excellence in BMS:

Global Production Portfolio to Reach Long Term CO_2 Reduction Targets

- BMS committed itself to reduce the specific CO_2 emissions by 40 % per metric ton sold product until 2020 (base year 2005)
- The Bayer Climate Check guarantees a systematic identification of Energy Efficiency improvement potentials visualized in an Energy and CO_2 Savings portfolio
- *STRUCTese*™® as an Energy Management System focuses on the sustained realization of savings opportunities and links current consumption to the true minimum
- *STRUCTese*™® is established in the BMS Operational Excellence Processes and is going to be implemented globally at 60 production plants until end 2012

Results of STRUCTese™® in BMS's Global Production World

- **45 BMS plants out of 60 are analyzed with STRUCTese™**
- **The 60 plants cover more than 85% of BMS's total Energy Consumption**

Identified Energy Savings:

A-Measures: 7 %,
(economical and technical feasible)
B-Measures: 10 %,
(Economics or technical feasibility challenging)

Identified CO_2e emissions Savings (A-Measures):
~ 350 000 t CO_2e p.a.

Realized savings until 2011: - 175 000 t CO2 - 585 000 MWh

THANK YOU

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