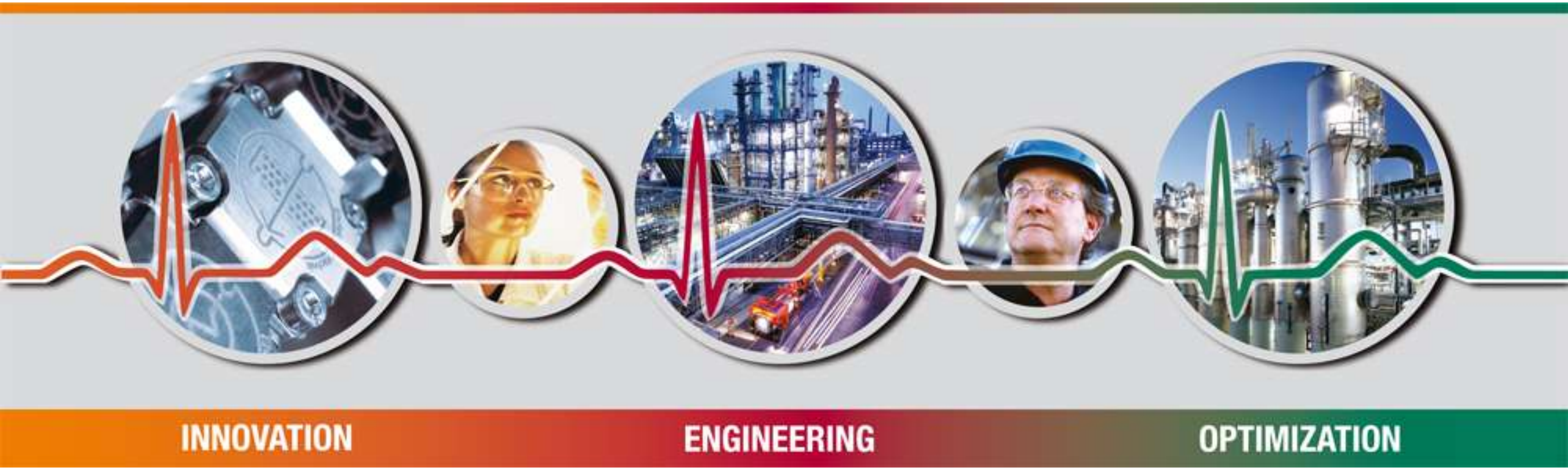
Powering Your Performance



Bayer Climate Check

- a glance of BTS Climate Check expertise

Bharuch, August 30th 2010

Jagdish Solanki

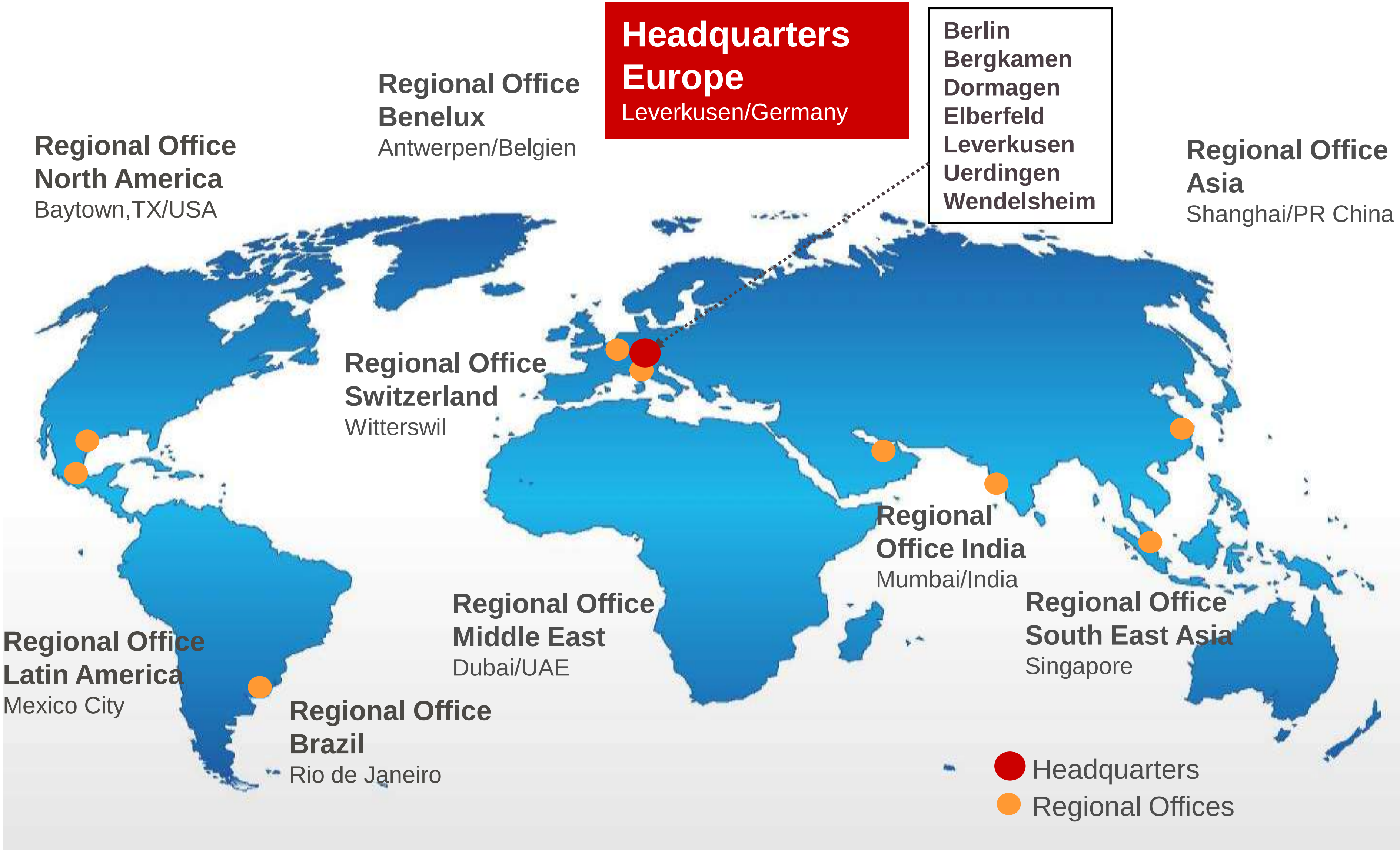
BTS India

Bayer Technology Services

Agenda

1. **Introduction of BTS-India**
2. **Introduction of the Bayer Climate Check**
   - Climate Footprint
   - Energy Efficiency Check
   - Workflow of the Climate Check
   - Data required by customer and results delivered by BTS

International Locations / Offices



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BTS India all set to cater to the Indian Customer

The BTS India operation started in year 2008 and is now fully manned with engineers from all the engineering disciplines.

A ECO Industrial Park Site Master Planning project for a major multi product SEZ site in Andhra Pradesh with more than 5000 acres of land utilization has been guided for the APIIC development by BTS expertise and is now under the EIA approval stage. (Cooperation with APIIC, gtz and BTS as the International Expert Consultant guiding the work of a well known Indian Consultant).

Project Management Consultancy for the prestigious projects of Bayer MaterialScience in India.

Actively promoting the inhouse developed and patented technologies:

- CLIMATE CHECK, a tool to reduce CO_2 emissions / energy demand and to reduce the CO_2 footprint of the products.
- Environmental solutions in the field of Waste Water and Waste gas emissions.

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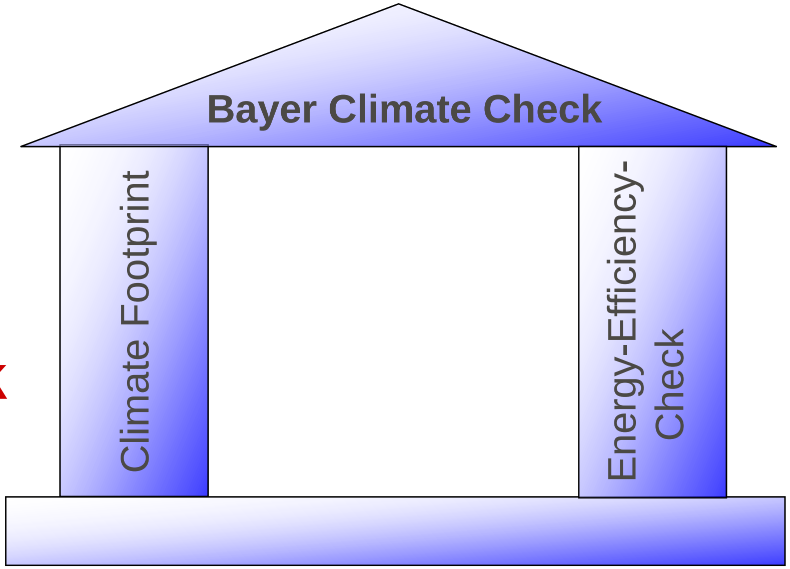
Bayer Climate Check: Main Characteristics

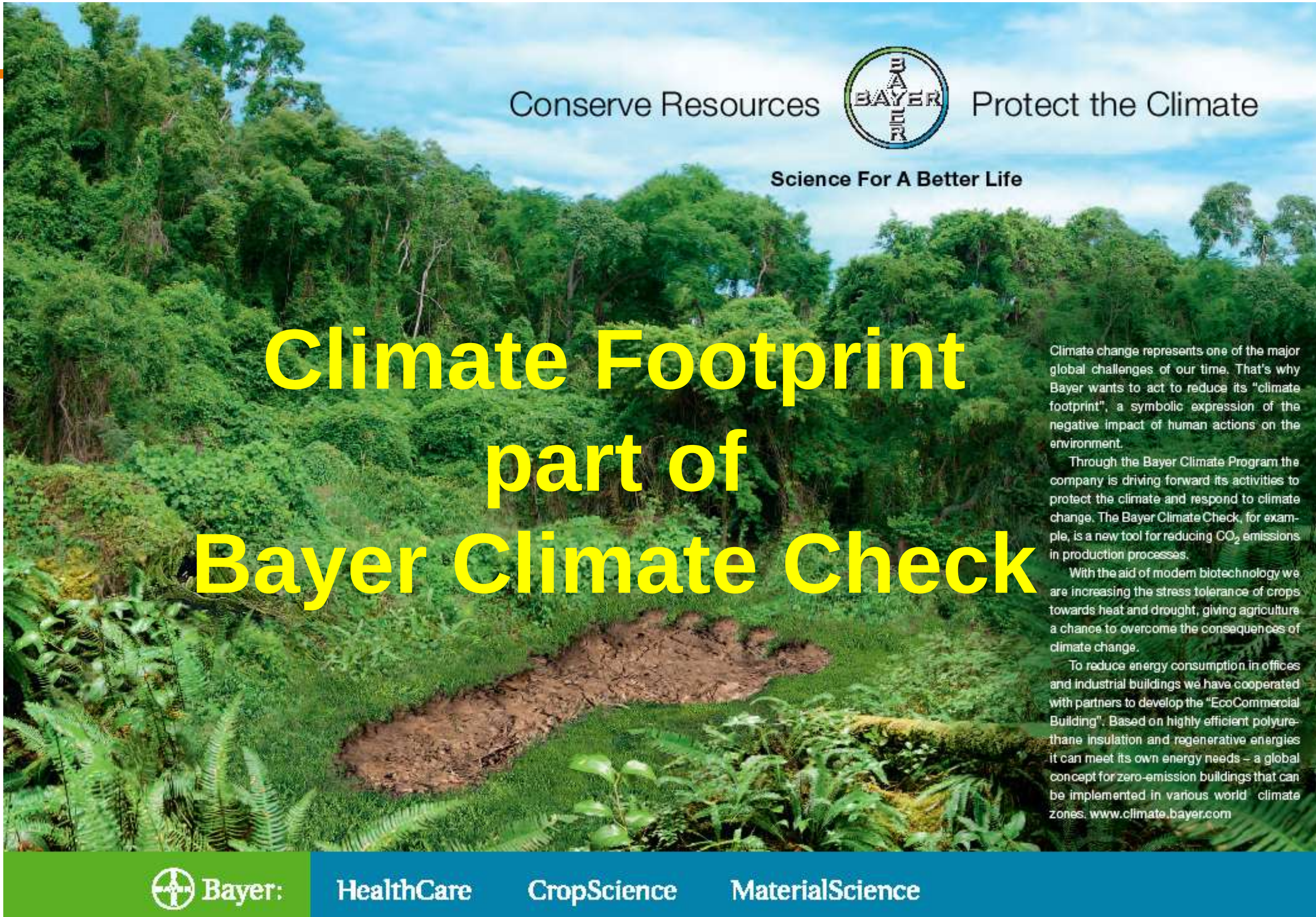
The Bayer Climate Check

- **consists of two elements:**
  - **Climate Footprint**
  - **Energy Efficiency Check**



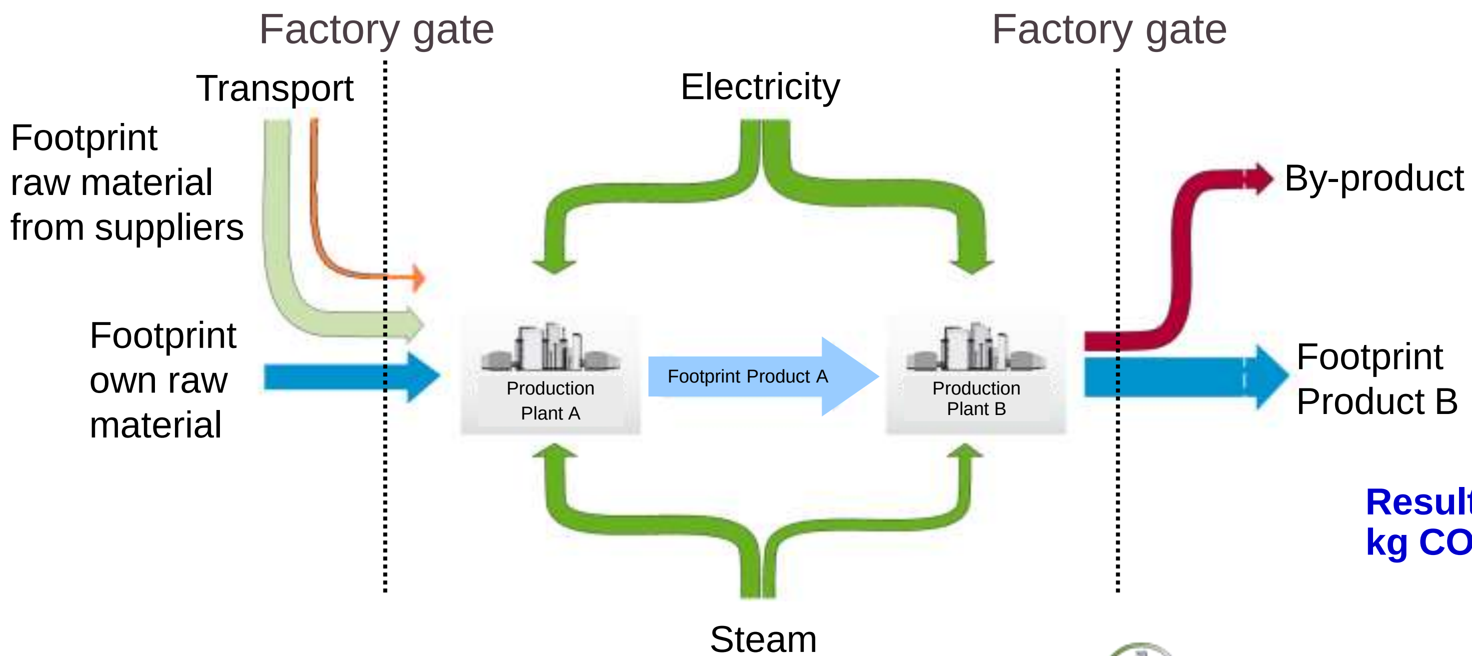
- **is a systematic screening of all relevant production units to identify measures for energy & CO_2e emission reduction**
- **supports achievement of targeted climate goals of your organization**

Climate Footprint part of Bayer Climate Check



The Climate Footprint is the KPI to assess the total Climate Impact

- A new indicator to assess climate impact of your production processes
- Based on the Life Cycle Analysis method
- Takes into account the influence of energy consumption, raw materials, logistics and direct emissions
- Data acquisition by a detailed questionnaire



Resulting in:
kg CO_2e / kg product

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Carbon, CO_2, Climate, …, Footprints: Semantics and definitions.

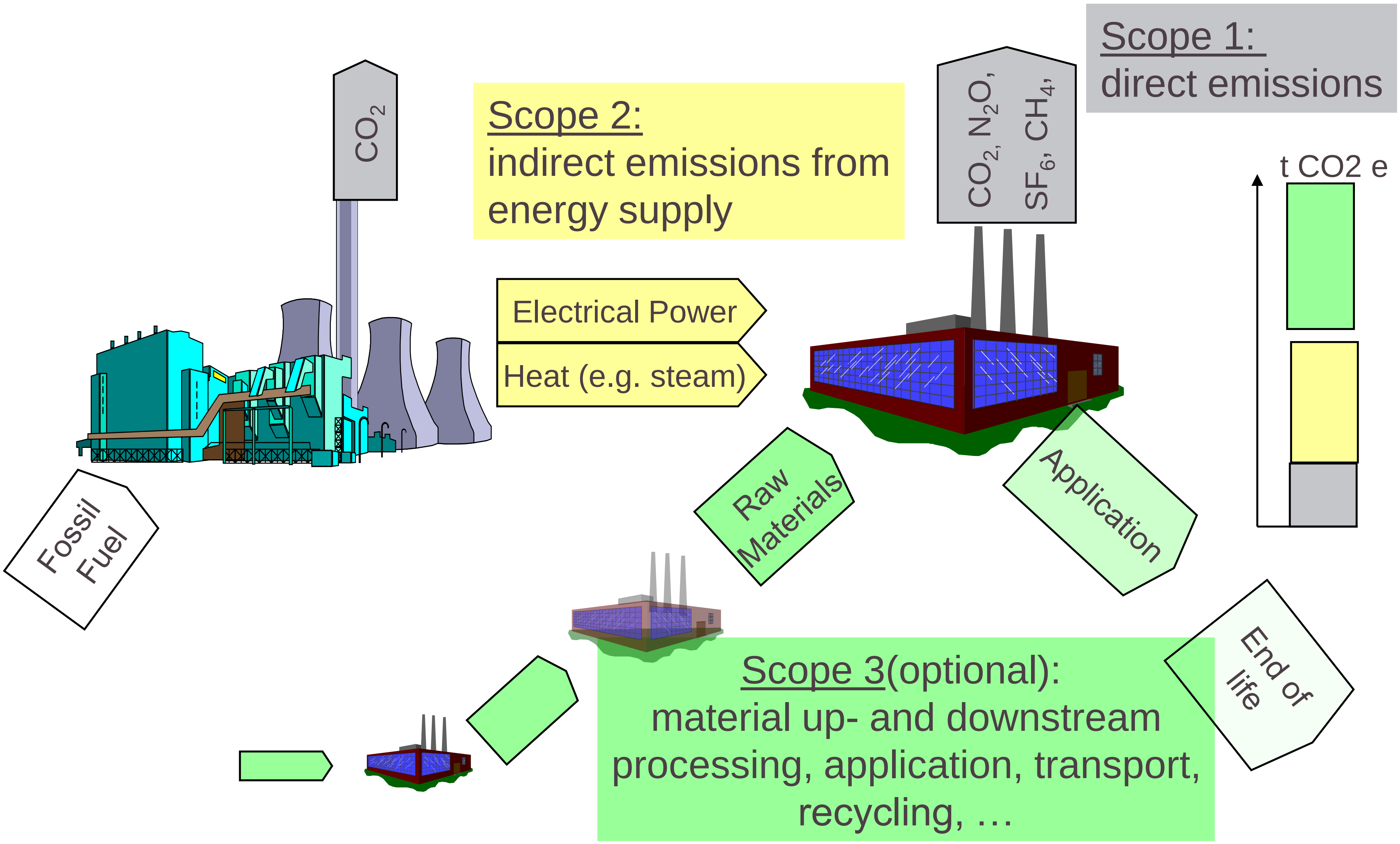
- *Carbon Footprint* or *CO_2 footprint* are frequently used phrases with ambiguous meanings.

  In simple word, ***Carbon Footprint*** *can be defined as :*

  A carbon footprint is a 'measure of the impact of human activities leave on the environment, directly and indirectly or is accumulated over the life stages of a product, in terms of the amount of green house gases produced, measured in units of carbon dioxide'.

- Definition is usually taken from Life Cycle Analysis (LCA) standards (e.g. ISO 14040). Coverage is all gases based on their green house gas potential measured in t CO_2e.
- LCA covers many more sustainability aspects beyond the carbon footprint.
- Application of the phrase carbon footprint is very wide, e.g. products, companies, production units (plants, sites, …), buildings, services, …
- Product Carbon Footprints (PCF) are already partly used for product labeling
- The Bayer *Climate Footprint*® is based on the standards for LCA and it is the certified method within the *Bayer Climate Check*. Commercial tools and databanks are used.
- *Climate Footprint* ® is a registered trade mark for BTS.

CO_2 emission reporting according to GHG Protocol distinguishes 3 scopes



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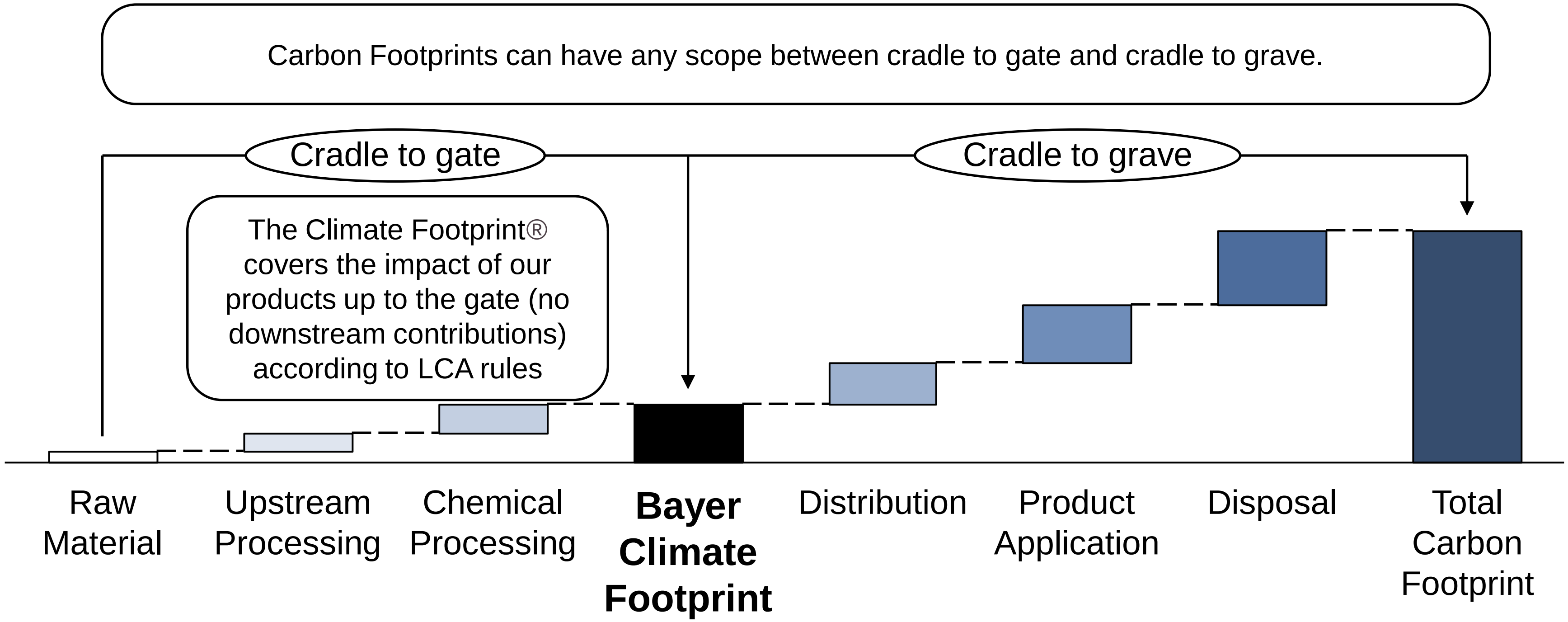
Role of CO_2 emission scopes (Carbon Footprint standards do not distinguish scopes).

- Scope 1: direct emissions from a plant or product
  - Most established and published
  - Is clearly regulated for large scale GHG emitters (power plants, steel plants, refineries, …) and emissions require tradable certificates
- Scope 2: indirect emissions from energy consumption
  - Recently voluntarily reported by companies and organisations (e.g. Carbon Disclosure Project).
  - No legal regulations exist today for reporting, not part of the certification or trading system
- Scope 3: other indirect emissions from raw materials, product usage, …
  - Not standardized reported by companies though still used
  - **Lifecycle Carbon Footprints, Product Carbon Footprints:**
  - In public discussion for product labeling, pushed e.g. by NGOs, retailers (WalMart, Tesco, ...), and authorities
  - Requests from purchasers for carbon footprints of commodity chemicals has started (e.g. caustic soda), Johnson Controls

The Climate Footprint® is designed to cover the relevant CO_2 contributions for production units.



Upstream:

Unique allocation of production route

unique CO_2 allocation

→ distinct footprint

Downstream:

Manifold product & lifecycle routes

Assumptions and vague approximations

→ ambiguous footprint

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The role of the Climate Footprint in your organization

- The Climate Footprint® extends an economic energy efficiency program (Energy Check) to the Climate Check.
- The Climate Footprint® covers the elements that your organization as product supplier could influence.
- The Climate Footprint® helps
  - to understand the climate impact of our products concerning raw materials, the supply chain and energy consumption.
  - to quantify CO_2 reduction potentials identified by Energy Efficiency Check
  - to prepare your organization for the ongoing public discussion on carbon footprints and CO_2 reporting according to Scope 3 (but no use phase for the time being)

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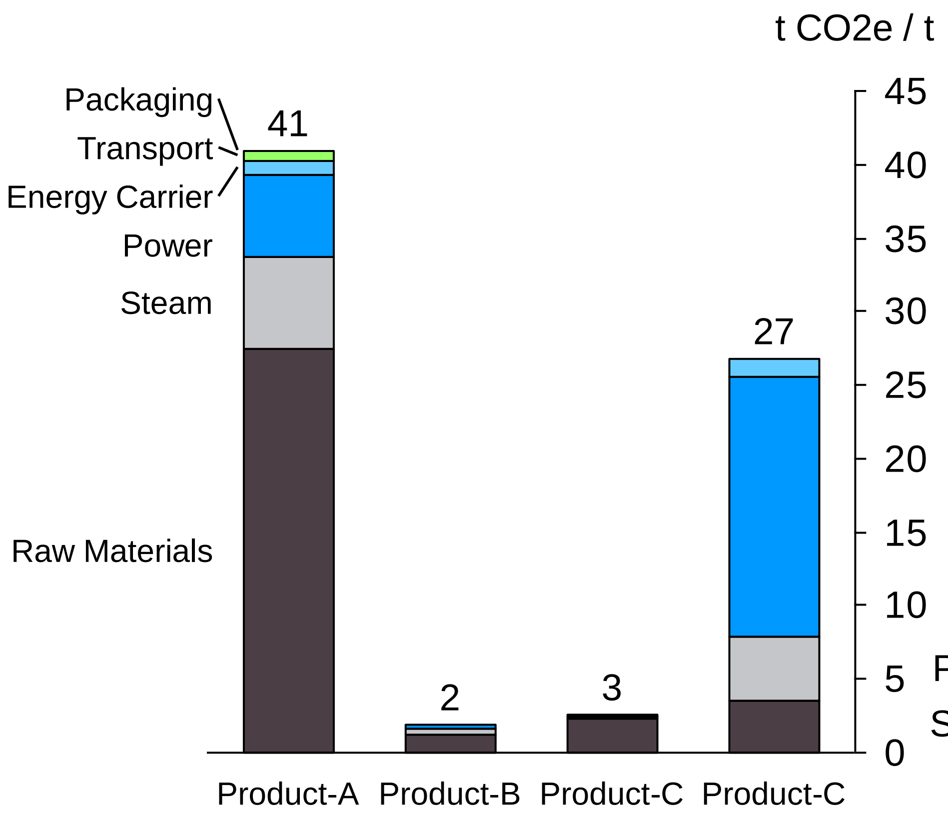
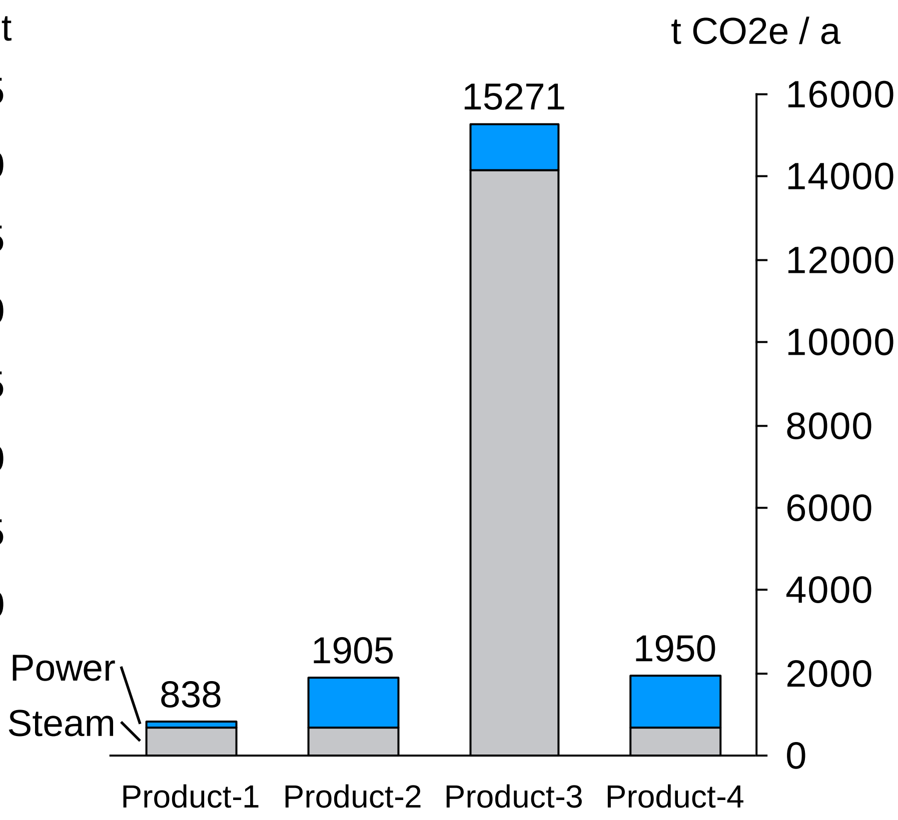
The Climate Footprint® shows the individual contributions
The Energy Efficiency Check shows the reduction potential

Examples for Climate Footprints



Annual reduction potential from Energy Efficiency measures



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The Climate Footprint® takes a pragmatic approach to assess climate impact with limited effort

- There is no absolutely correct value of a Climate Footprint®. Correctness is a matter of making appropriate assumptions and applying an accepted (certified) methodology. Accuracy is a matter of data gathering and detailing the production chain.
- The Climate Footprint® is designed to deliver meaningful results with limited cost and amount of work
  - Use established databank values where available
  - Application of Proxies for complex raw materials
  - For multi-purpose plants:
    - select major products
    - Lump products and create typical footprints rather than many individual
  - Typically scope to budget for 5 – 8 days is possible (data gathering at plant/site not included)

Carbon Footprint, other approaches & public expectations

- Retailers push the Product Carbon Footprint to differentiate from competitors.
- NGOs push the Carbon Footprint as an industry independent tool to avoid green washing
- Politics is looking for cross-industry applicable methods.
- Non-energy intensive industries (e.g. IT, communications) introduce carbon footprints. This creates pressure on the energy intensive industry.
- Winners of a „low carbon society“ push the carbon footprint.
- PCF are used where it promises opportunistic advantages. No systematic and comparability of current approaches.
- Most companies communicate the value of their products.
- BTS offers the calculation of Carbon Footprints according to LCA standards as a service.

Product Carbon Footprint: Example Tesco (UK)

Every little helps

- 20 products in the following categories:
  - Laundry Detergent
  - Orange Juice
  - Potatoes
  - Light bulbs
- Launched 29th April

TESCO

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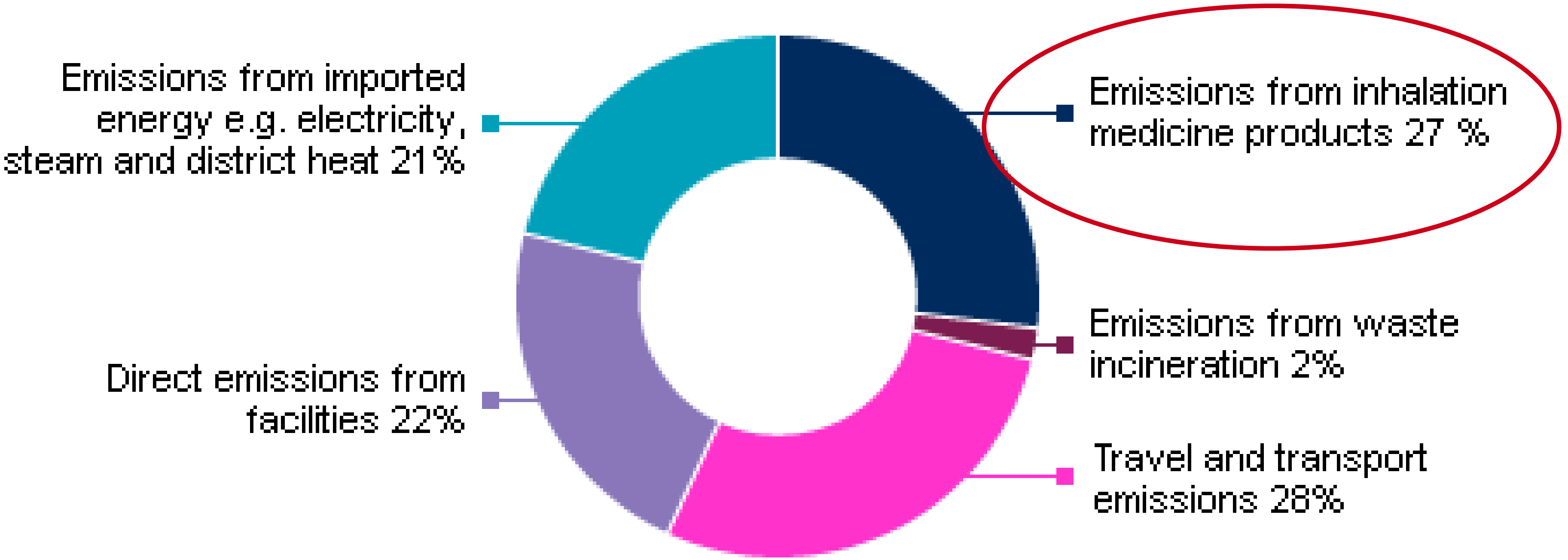
CO_2 communication: example AstraZeneca

- AstraZeneca also reports scope 3 emissions and admits that these emissions will increase (probably foresighted approach to avoid possible threats from PCF)

Total GWP emissions 2007: 1.29 million tonnes



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How to get data for the Climate Footprint

Data Acquisition by a questionnaire concerning:

- Energies
- Utilities
- Raw Materials, Products and byproducts
- Auxiliaries
- Transportation
- Waste and waste treatment
- And all further possible sources of emissions (e.g. refrigeration, direct emissions)

Example

results in:

- as-is-state (basis scenario) of the plant
- Documentation of the technical processes

The Climate Footprint is certified by TÜV Süd

ZERTIFIKAT ◆ CERTIFICATE ◆ СЕРТИФИКАТ ◆ CERTIFICADO ◆ CERTIFICAT

TÜV SÜD

Industrie Service

ZERTIFIKAT

Die Zertifizierstelle „klima und energie“
der TÜV SÜD Industrie Service GmbH

bescheinigt, dass das Unternehmen

Bayer Technology Services

Bayer Technology Services GmbH
51368 Leverkusen

für den Geltungsbereich

Management Methode

Bayer Climate Footprint*

*exklusive Koppelproduktion

die Voraussetzungen erfüllt und entsprechend dem

CMS Standard GHG 03

ein THG-Management-System eingeführt hat.

Durch den Audit der Pilotanlage „Baytown“, Bericht-Nr. **1063236**, wurde der Nachweis erbracht, dass diese Anforderungen erfüllt sind. Die Gültigkeit des Zertifikates wird jährlich überprüft.

Zertifikats-Nr.: **03.0007.08**

München, 2008-04-23

Zertifizierstelle „klima und energie“

TÜV SÜD

TÜV SÜD

TÜV®

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Energy Efficiency Check
part of
Bayer Climate Check

The Energy Efficiency Check…

- identifies measures for energy & CO_2e emission reduction
- applies of a wide range of state-of-the-art methods and tools in a systematic approach
- brings together the experience of plant engineers and operators
and BTS experts from several competencies

BTS has successfully executed more than 40 projects

Customers are: BMS, BCS, BHC, Currenta, Lanxess,
Saltigo, H.C. Starck, Ineos, Clariant

Energy Efficiency Check – Workflow

An Energy Efficiency Check comprises three steps

- Analysis
- Idea Generation
- Evaluation

Results: List of feasible improvement suggestions

- Savings potential
- Costs (rough estimate, if possible)
- Profitability (rough estimate, if possible)

Implementation and after sales services optional

- Sustainable Implementation with Monitoring of identified energy efficiency projects
- After Sales Service

Energy Efficiency Check – Workflow

Analysis

Idea Generation

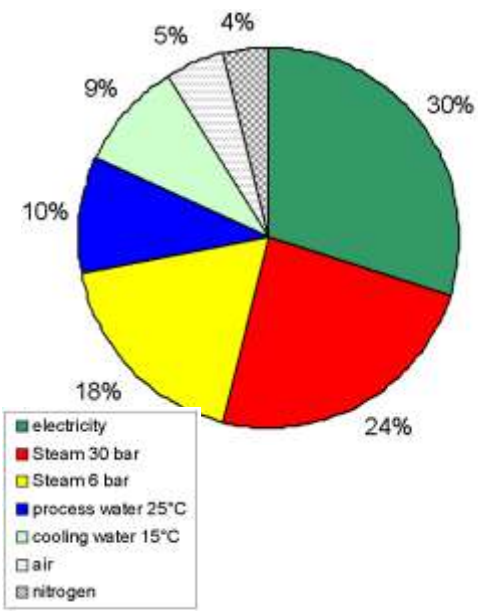
Evaluation

Example

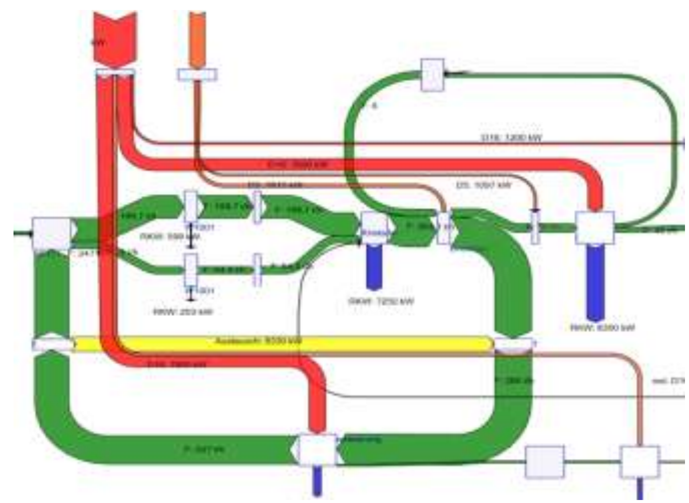
Analysis

- Goal: - identification of main levers for energy reduction
  - acquisition of data
- Determine and quantify energy consumers / producers
- Determine relevant data of energy consumers / producers, e.g. power, temperature, flows, technical equipment data
- If reasonable: build / update process model
- Result: consistent data base -> reference case

Energy Distribution



Sankey Diagram



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Comprehensive Energy Audit – Workflow

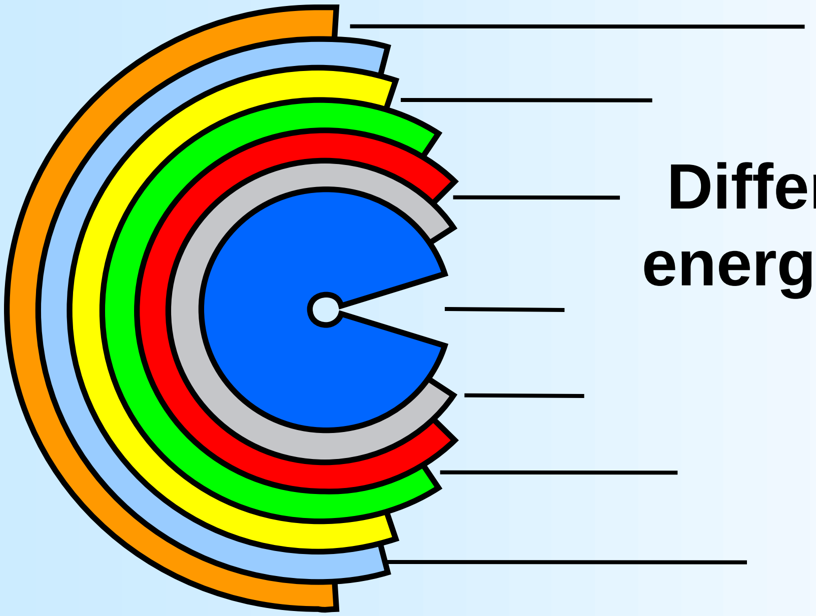
Analysis

Idea Generation

Evaluation

Idea Generation

- Goal: determination of measures for energy reduction
- Application of a wide range of state-of-the-art methods
- Improvement measures range from simple operational adjustments to complex adjustments



Different levels of energy optimization

How?

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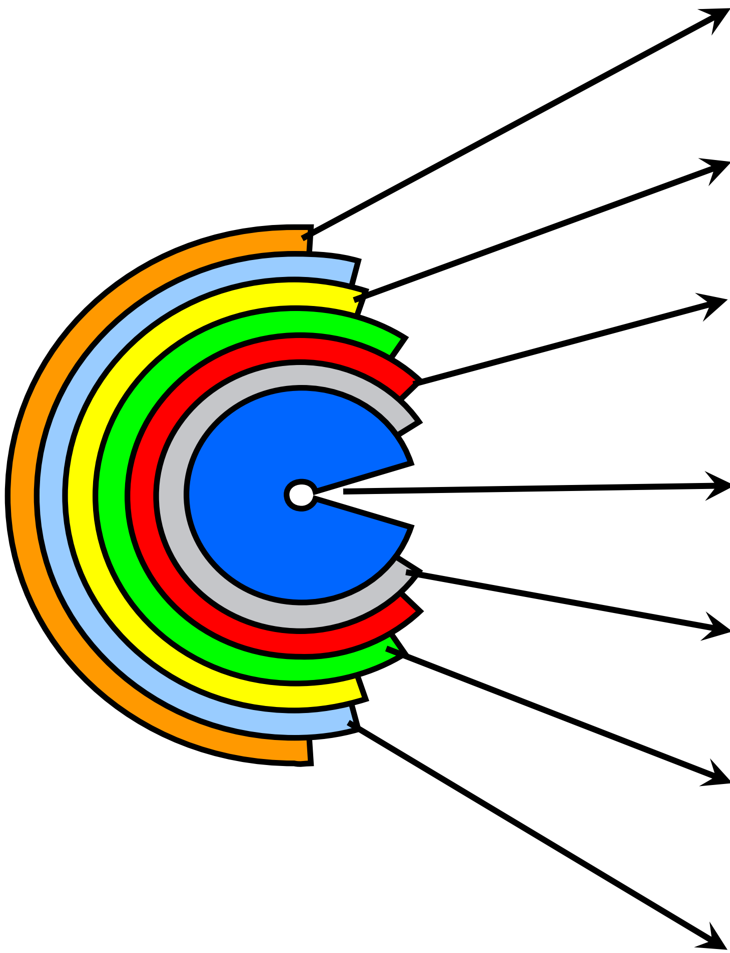
Comprehensive Energy Audit – Workflow



Energy & Utility Supply
Assess efficiency of energy generation and distribution

Raw Materials
Optimize raw material consumption

Heat Integration & Recovery
Check heat integration and waste heat recovery

Equipment Check
Evaluate large energy consumers by checklists

Operational Improvement
Optimize operating parameters and process control

Process Design Improvement
Optimize process design, check application of innovative technologies

Buildings & Facility
Assess heating, lighting and HVAC

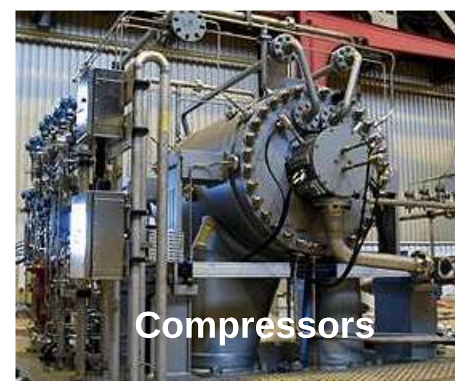
Energy Efficiency Check – Workflow

- Analysis
- **Idea Generation**
- Evaluation

Example

Idea Generation

- **Equipment check**
  - **Evaluation of performance of larger energy consumers**
  - **Checklists: check for best practice / benchmarking**
  - **Examples:**
    - large pumps: operating point, control strategy, frequency drive
    - heat exchanger: control strategy, cleaning program in case of fouling
    - unit operation such as dryer, high-viscous-equipment etc.



Energy Efficiency Check – Workflow

Analysis

Idea Generation

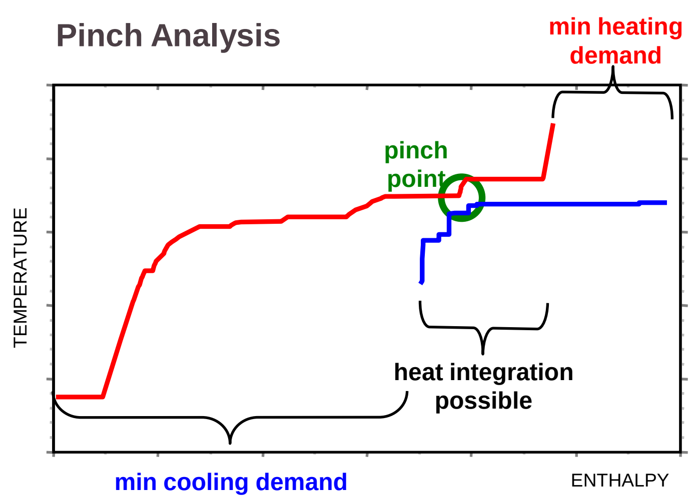
Evaluation

Example

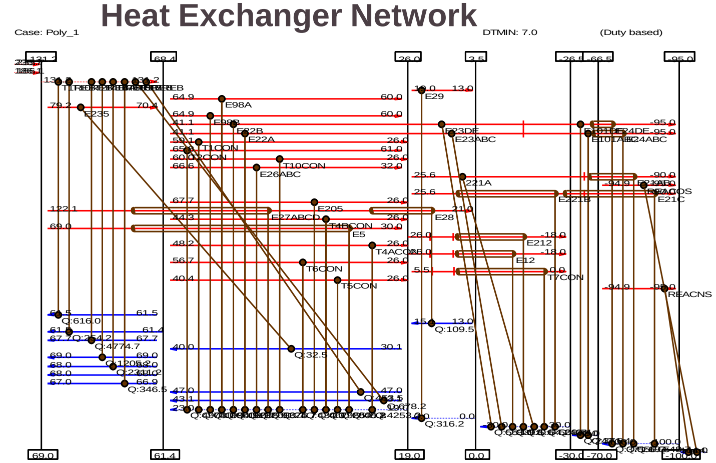
Idea Generation

- **Heat Integration / Heat Recovery**
  - **Pinch Analysis (if reasonable):**
    heat integration possibilities, heat exchanger network
  - **Total Site Analysis (if reasonable):**
    heat integration across plants e.g. via utility systems
  - **Heat recovery and reuse of waste heat:**
    check application of technical solutions such as absorption chiller, heat pumps, vapor recompression

Pinch Analysis



Heat Exchanger Network



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Energy Efficiency Check – Workflow

Analysis

Idea Generation

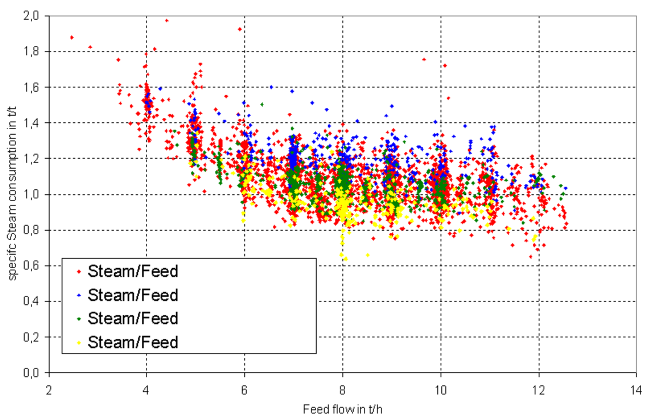
Evaluation

Example

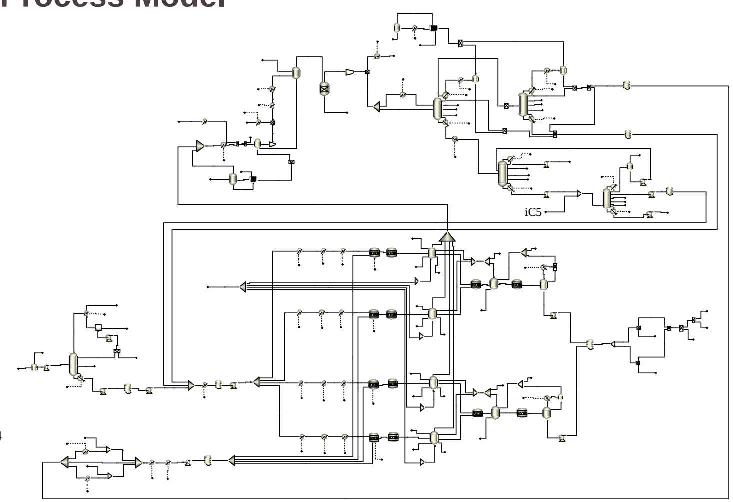
Idea Generation

- **Operational / Process Improvements**
  - **Improved process operation and process control: optimize operating parameters and set points, example:**
    - distillation: operating conditions, control strategy
    - scenario studies with process models:
      analyze effect of altering operating parameters
    - analysis of operating data
  - **Improved / alternative process design**
    example: replacement of trays by packing in distillation

Analysis of Operating Data



Process Model



Energy Efficiency Check – Workflow

Analysis

Idea Generation

Evaluation

Example

Idea Generation

- Energy / Utilities
  - Auditing of energy and utility systems (dependent on scope):
    e.g. steam and electricity generation, cooling towers, pressurized air, refrigeration, HVAC
    - assess utility generation by benchmarks and expert evaluation
    - assess utility distribution grids (e.g. leakage elimination, steam-trap maintenance, return / reuse of condensate)
  - Energy contracting:
    analyze energy contracts and check for suggestions for cost savings

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Energy Efficiency Check – Workflow

Analysis

Idea Generation

Evaluation

Example

Idea Generation

On-site

- **Brainstorming and interviews:**
  Goal: incorporate improvement ideas from plant management and operating employees

  Perform moderated sessions of open brainstorming and interviews with:
- Plant management / plant engineers
- Operating employees
- Experts from customer
- BTS experts

- **Facility Check:**
  plant inspection tours by energy experts,
  e.g. inspect insulation, assess illumination

Energy Efficiency Check – Workflow

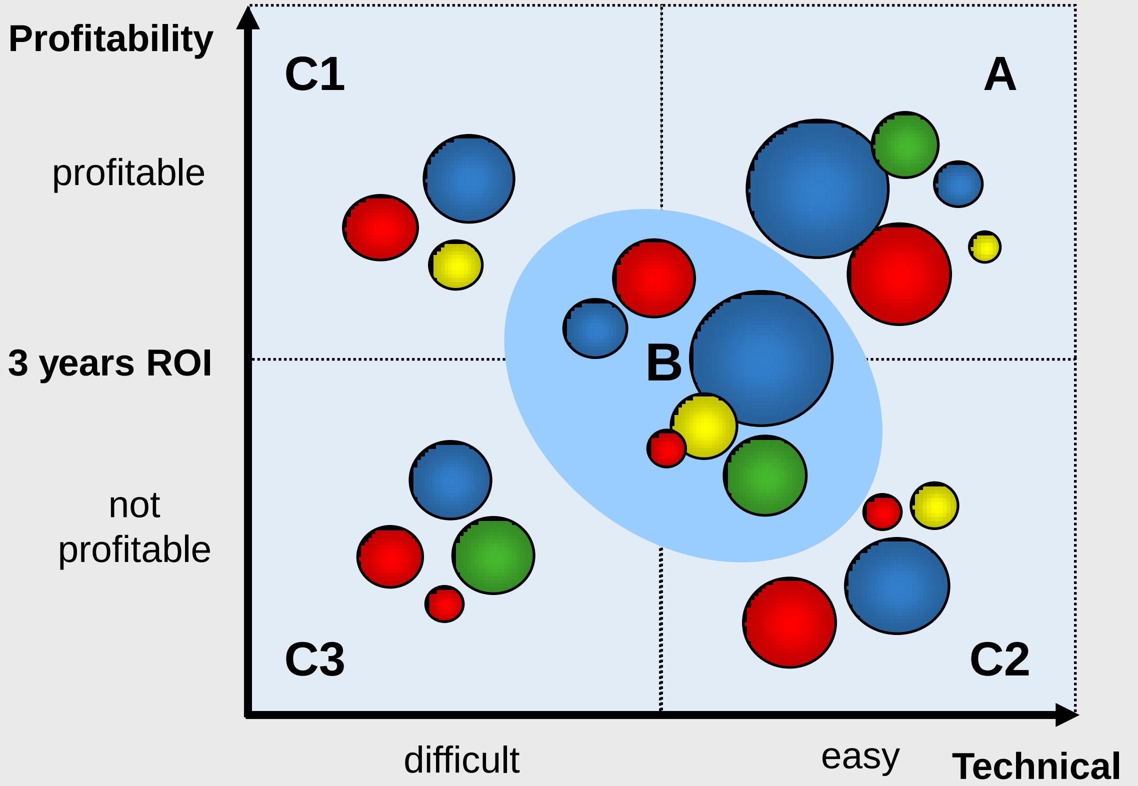
Analysis

Idea Generation

Evaluation

Portfolio

Evaluation



Portfolio Categories
A = feasible and profitable
B = likely feasible and profitable, needs further evaluation
C1 = technically (currently) not feasible but profitable
C2 = technically feasible but not profitable
C3 = technically (currently) not feasible & not profitable

Steam
Electricity
Coolants
Gases

Bubble Size = Savings Potential

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Energy Efficiency Check – Workflow

Example

- **Rough evaluation of measures for energy reduction with regard to:**
  - Feasibility
  - Savings potential
  - Costs (estimate)
  - Profitability (estimate)

- **Categories of feasibility :**

A	B	C (C1/C2/C3)
Feasible **e.g. proven technology, no obvious concerns**	Needs further Evaluation	Not Feasible

- **Result: list of feasible improvement suggestions with savings potential, costs and profitability**

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Energy Efficiency Check – Workflow

Provided by Customer

- Experienced contact persons on-site with process and operating knowledge (e.g. plant engineer), preferably one main contact person for the entire project
- Process flow diagrams, P&ID, equipment specifications and other relevant technical information
- Process description / process manuals if available
- All necessary data data identified in the pre-visit and data regarding the climate footprint
- Operating data
- Results of existing studies and projects
- Resources from key operating personnel, plant management and plant engineering for brainstorming sessions and interviews

Data required for preparation of offer and Kick-Off

Required data by data acquisition sheet

- **Data acquisition by a detailed questionnaire (excel) for each plant**
- **Necessary because of 2 reasons**
  - Proposal based on information won at Pre Visit and by data acquisition
  - Best preparation of future Kick-Off to start Idea generation efficiently
    - Which utilities are used ?
    - Which amounts of utilities are used ?
    - Which aggregates use which amounts of utility ?

    → Result: consistent data base -> reference case

Bayer Climate Check – What do you get ?

Provided by BTS

- **Power point presentation for each investigated unit with general information about Climate Footprint and Energy Efficiency Check**
  - Constraints and assumptions
  - Calculated footprints
  - Identified energy savings projects
  - summary
- **Detailed report for each unit about**
  - Additional detailed description of identified projects
- **Executive summary per Site**
  - Possible savings of energy, CO_2, costs
  - Payback time (if possible)
  - Category of measure (A,B,C)

Procedure for Project Planning and Execution

First Contact

Project Planning: Site Pre-Visit

- Rough estimation of complexity
- Check of data availability
- Check of availability of plant personnel
- Set-up of project schedule
- Duration: 1-2 days

Proj. Planning: Preparation

- Data acquisition by BCS
- Preparation of offer by BTS
- Duration: ~1 month

Project Execution

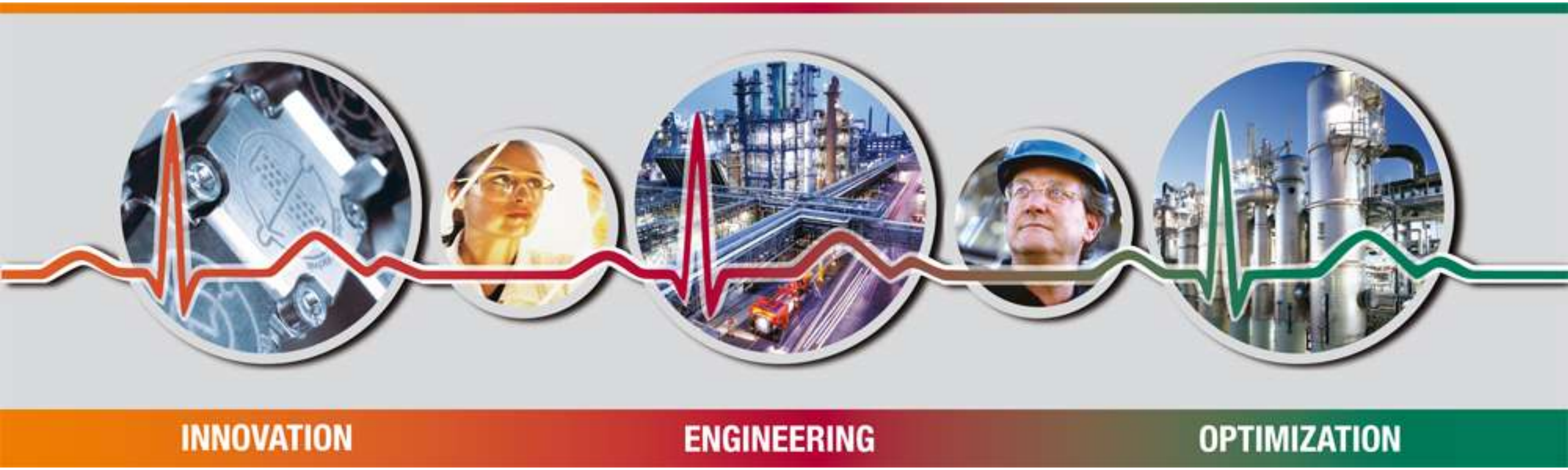
- Duration: ~ 2 months per unit

Unit A

Unit B

Unit C

Powering Your Performance



THANK YOU

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BACK UP SLIDES

Data acquisition by questionnaire

Raw materials

index number	Name of Raw Material	Quantity Used Per Year in tonnes/year	specific use for certain products (use letters from enumeration)	Source of Raw Material	Supply Mode of Raw Material	estimated distance to main supplier [km]	estimated load capacity of used transportation device [metric tonnes]
1	Schwefelkohlenstoff	4000	a,b,c	Supplier in Cologne	Tank waggon	35	52
2	Schwefelkohlenstoff	0	a,b,c	Supplier in Poland	Tank waggon	800	0
3	Propylendiamin	2250	a,b,c	Supplier in Leverkusen	Tankcontainer	30	23
4	Ammoniakwasser	537	a,b,c	Supplier in CP Dormagen	via pipeline	on Site	0
5	Zinksulfatlauge	15520	a,b,c	Supplier in CP Uerdingen	Tankcontainer	50	23
6	Natronlauge	16400	a,b,c	Supplier in CP Dormagen	via pipeline	on Site	0
7	Galoryl	288	a,b,c	Supplier in France	Tankcontainer	600	20
8	Borrespeerse	964	a,b,c	Supplier in Norway	Tankcontainer	900	25
9	Hexamethylentetraamin	77	a,b,c	Different suppliers	Paper-bag	on site	0
10	Silitin WP 70	525	b	FL-plant	via pipeline	on Site	0

Emissions

Name of Waste	Quantity Per Year	Units	Condition of waste	further information ?
FCKW	**0.206**	**t/a**	**gas**	Abgabe an TVA DOR. Frigene werden zerstört

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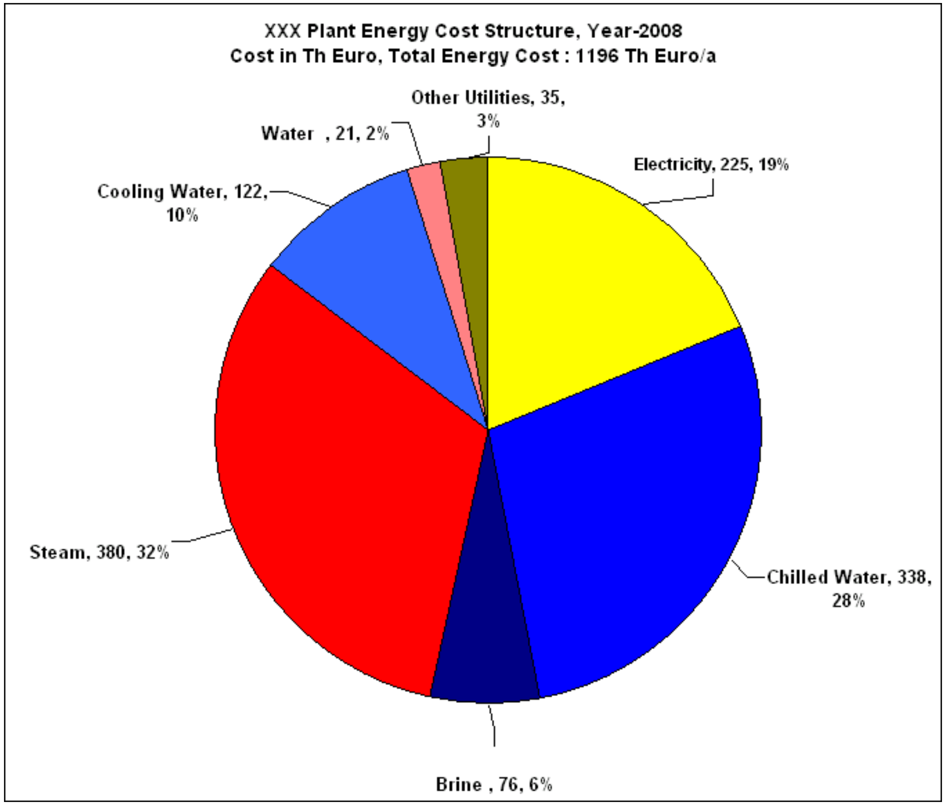
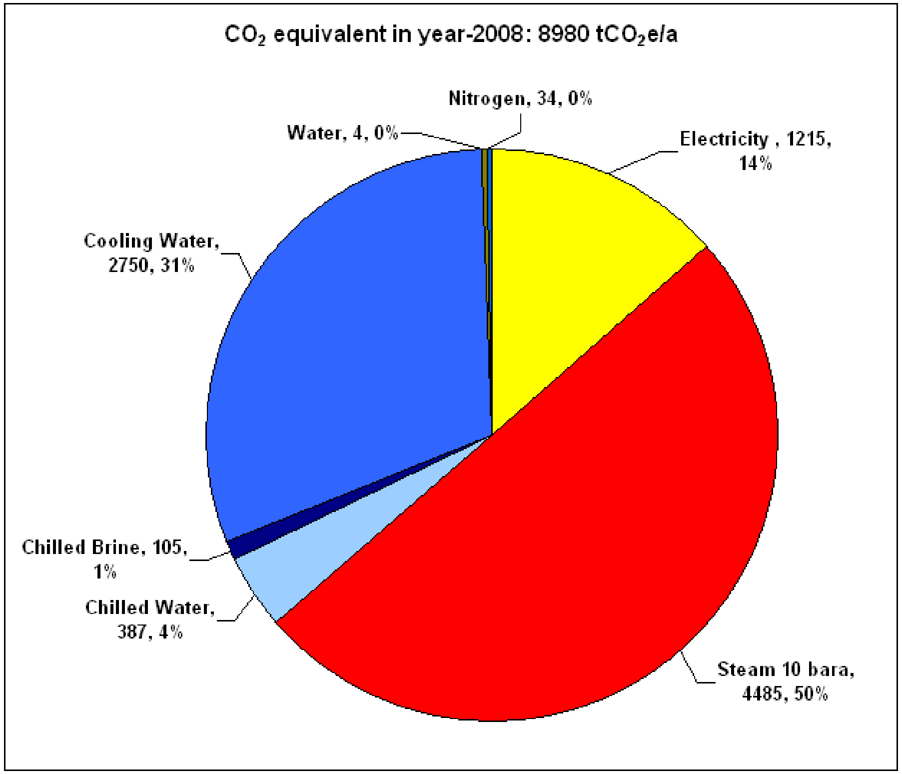
Cost and Energy (CO_2eq.) distribution





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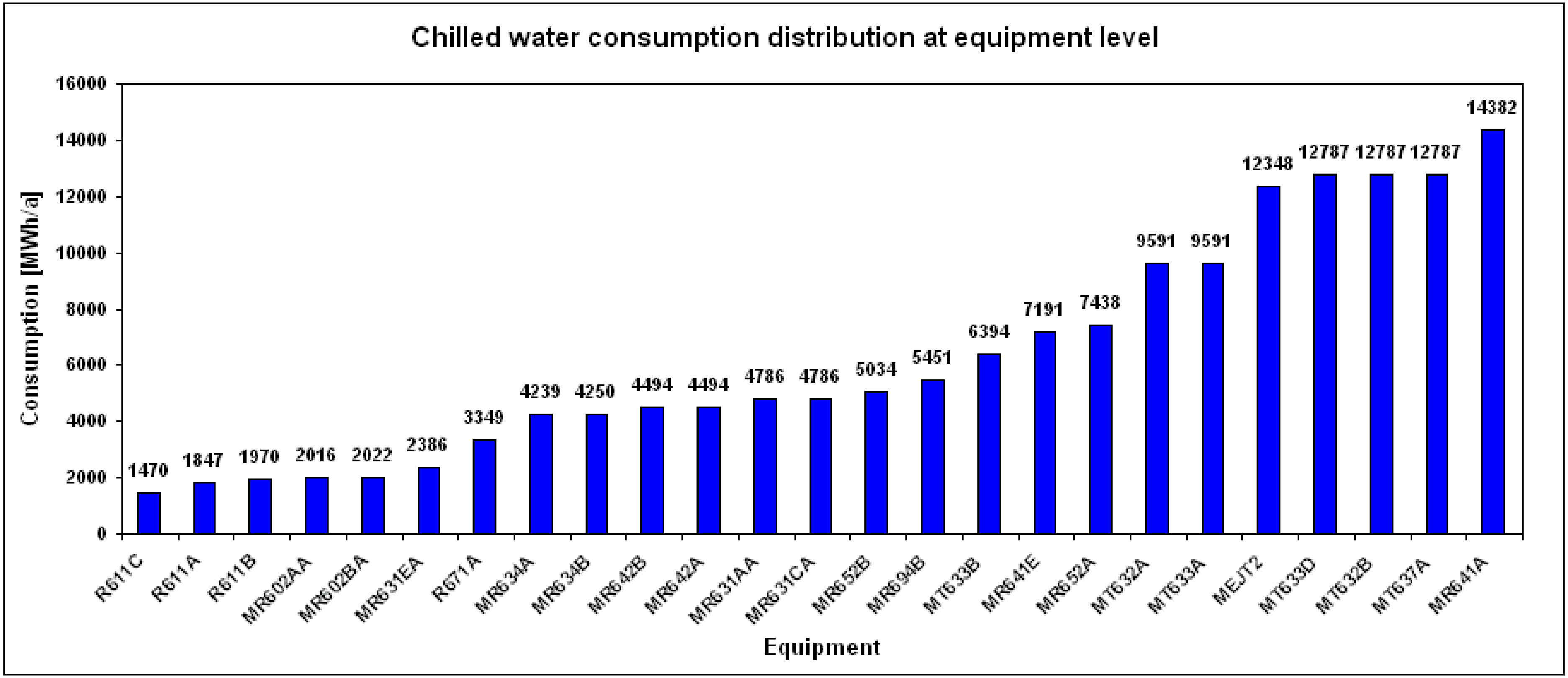
Determination of relevant energy consumers in plant



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Equipment check spray dryer in plant XX

Initial Situation

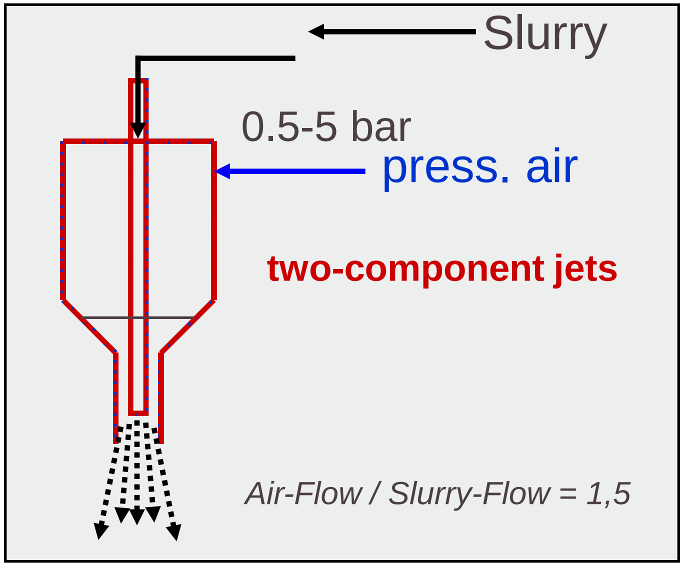
- **2 existing spray dryers are equipped with two-component jets with external mixing**
- **Required atomization of Antracol-slurry in two-component jets is realized by large amounts of pressurized air**

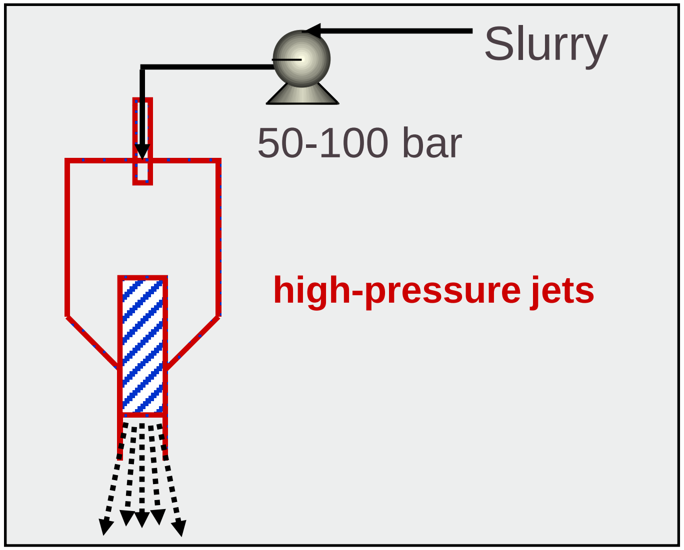
Approach

- **Slurry atomization with high-pressure jets**
- **Therefore, installation of new high pressure pump required**

Results

- **Measure will lead to savings of pressurized air (19 million Nm³/a, 12 % of total energy costs)**
- **Constraints:**
  - **Installation of new high pressure pump**
    - check pump availability
    - check particle size distribution
  - **New pump needs electricity**





Category B

FU Dormagen - Heat integration in FU1

Initial Situation

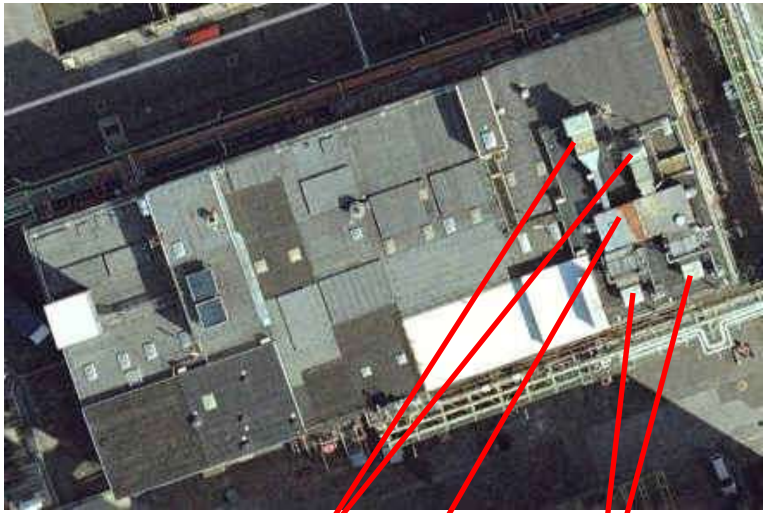
- **Required air for spray dryers is heated up from 10 °C to 180 °C with steam (30 bar)**
- **Off-gas from spray dryers is emitted to environment, temperature above dew point (about 85 °C), volume flow: ~ 30.000 m³/h**

Approach

- **Heat Integration: new heat exchanger to preheat cold air with off-gas**

Results

- **Measure will lead to savings of 30 bar steam (10,4 % of total energy costs)**
- **Constraints:**
  - **Installation of heat exchanger is dependent on**
    - capacity of steel construction
    - required permission (new waste water stream)
  - **Corrosion and fouling of heat exchanger need to be considered**



Category B

Condensate recovery at site

Condensate Recovery for Entire Site, Bayer Cropsciece Site XXX

Sr No	Plant Name	Allocated Steam Consumption	Theoretical Available Condensat	Present Condensat e	Steam send to NDCT	Available Condensat e	Delta T	Specific Heat of Water	Boiler Efficiecny	Available Thermal Heat Load	Calorific Value of NG	Saving in NG Consumpt	Cost Saving in NG		Assumed operatin g hours	NG saving in 1000 Sm^3/hr
		t/a	t/a	t/a	t/a	t/a	C	kJ/kg°C	%	MJ/a	kJ/Sm^3	Sm^3 /a	INR/a	€/a	hr	1000 Sm^3/hr
1	**Plant-1**	5523	4971	0	1149	3822	50	4.187	84%	800073	36732	25930	311162	4787	8000	0.00324
2	**Plant-2**	23856	21470	2535	2854	16081	50	4.187	84%	3366641	36732	109112	1309345	20144	8000	0.01364
3	**Plant-3**	14227	12804	9508	3119	177	50	4.187	84%	37118	36732	1203	14436	222	8000	0.00015
4	**Plant-4**	13847	12462	0	1553	10909	50	4.187	84%	2283862	36732	74019	888234	13665	8000	0.00925
5	**Utility Block-1**	21067	18960	18960	0	0	50	4.187	84%	0	36732	0	0	0	8000	0.00000
6	**Utility Block-2**	7091	6382	6382	0	0	50	4.187	84%	0	36732	0	0	0	8000	0.00000
7	**Utility Block-3**	7154	6439	6439	0	0	50	4.187	84%	0	36732	0	0	0	8000	0.00000
8	**Remaining Plant not in Scope**	48925	44033	4403	17613	22016	50	4.187	84%	4609102	36732	149380	1792560	27578	8000	0.01867

Total natural Gas Saving	359645	Sm^3/a
Natural Gas Price	12	INR/Sm^3
Cost Saving in INR/a	4315737	INR/a
Cost Saving in €/a	66396	€/a
Assumed operating hours	8000	hr
Natural gas saving in 1000 Sm3/hr	0.04496	1000 Sm^3/hr

Assumptions

1 The available condensate of entire site can be collected in one common tank and then to be utilised for prehating of boiler feed water, as the condensate collected in insulated tank temperature is assumed 85°C
2 The avareage temperature of available DM Water (to be used as a feed water for boiler) is assumed as 35°C and so ΔT= 50°C
3 Condensate Flashing Loss = 10 %
4 Boiler Efficiency = 84%
5 For the plants which are not in scope of climate check It is assumed that 10% of total steam consumption condensate is recovered

Idea generation

Idea Generation, Brainstorming : XXX Plant

Sr. No	Title	Description	affected utility	Name of Author	Category
1	Vacuun booster instead of steam ejector	Steam is the major consumer in plant so can a vacuum booster be used instead of steam ejector	Steam	Manoj Tank	++
2	Energy efficient motor	TBAC distillation reactor R622A/B motor to be replaced by energy efficiency motor	Electricity	Jagdish Asawa	+
3	Brine circulation	Brine circulation (H.E.) valve to be closed where not required	Brine	Jagdish Asawa	+
4	Condensate collection	Steam Condensate to be collected and use for Sodiuns bicarbonate preparation	Steam	Jagdish Asawa	+
5	Steam trap checking	Steam traps to be checked	Steam	Jagdish Asawa	0
6	Auto shut off for ejectors and interlocks for pumps	Auto shut off valves for steam ejectors interlocks with circulating pumps & vacuum valves to reduce staem consumption	Steam, Electricity	Snehal Patel	++
7	Hot oil heating	Use hot oil heating system instead of steam heating	Steam	Bipin Patel	-
8	VAMP. Cilculation pump	DICO plant chilled water return circulation in VAMP. Require prope instrumentation. Flowmeter, control valves, return temperature, RTD, etc.. So VAMP circulation pump stop	Chilled Water, Electricity	Jaymin Vashi	-
9	LP steam line size	Changes in LP Steam line size in recovery reactors with minimum loops	Steam	Prashant Khachare	0
10	Line size	Chilling line size to be modify in recovery HE's with poper line loops	chilled water	Prashant Khachare	+
11	Interlock for MH603 C9 HE	MHT603 C0 HE chilling supply line autoactive (interlok) to get C9 supply temp. instead of continious chilling supply	chilled water	Prashant Khachare	-
12	Energy efficient motor	Energy efficient motor for >15kW	Electricity	Jagdish Solanki	++
13	Performance Measurement of cooling towers	Performance Measurement of cooling towers	Cooling Water, Electricity	Jagdish Solanki	0
14	VFD for Pumps	VFD for cooling tower circulation pumps	Electricity	Jagdish Solanki	+
15	Hexane preheating	Hexane feed can be preheated by condensate to reduce the steam consumption	Steam	B. Tiwari	0
16	Dry vacuum pump instead of steam ejector	Dry vacuum pump can be used in place of steam ejector (2CB preparation, crystallization, distillation)	Steam	B. Tiwari	++
17	Increase Distillation rate	Increase rate of distillation can help in reduction in ejector steam	Steam	B. Tiwari	0
18	High efficiency pumps for cooling tower with energy efficient water	High efficiency pumps for cooling tower with energy efficient water	Electricity	D. Panchal	--
19	Distillation Column	preheating with vapor condensation	Steam	D. Panchal	-
20	APFC control at plant level	APFC control at plant level	Electricity	D. Panchal	--
21	Process Optimization	Reduce solvents in process wherever possible of solvent to be distilled	Steam	D. Panchal	0
22	On /Off valve for condensers	On /Off valve for condensers →Chilled Water →Brine	Chilled Water/Brine	D. Panchal	+
23	Descaling of condensers	Descaling of condensers →Preventive maintenance schedule is required to keep efficiency of heat transfer is not deteriorated	Chilled Water/Brine	S. L. Kadwe	+
24	Recycle hot condensate for steam generation	Instead of recycling back the condensate to cooling tower basin export that for steam generation. C.T. efficiency lost is very big of done the recycling to cooling tower	Steam	A. M Siddique	-
25	Steam trap revise	Higher type of steam trap for difference heating application and regular maint.	Steam	A. M Siddique	+
26	Insulation	Good insulation with international Standard. Critical thickness of insulation concept where needed	Steam/ cooling utilities	A. M Siddique	-
27	Condensate recovery	Steam trap water to be use for process consumption where (H2O warm) is needed. i.e. carbonate preparation	Steam	Bhaumik Pathak	+
28	Recycle of low GPL	Low GPL of residue should be recycled		Bhaumik Pathak	--
29	Cooling tower - trimming	Cooling Tower: Impeller Trimming or VFD, detla T , increase delta T to 5 °C	Cooling Water, Electricity	Jagdish Solanki	++

Evaluation of measures

Bayer Technology Services | Jump to Overview | **Potential description**

Project No:	Process / Plant:	Title:	To replace VAM with Screw compressor for chilled water generation					
15	Utility	Date 20/05/2010			by J. Solanki	Rev. 1	Unit/AKZ All VAM	Sheet 1

Project Summary: Status Quo and Optimization Idea

Current Situation:
Currently Chilled water is produced by vapor absorption machines which is operated with 8 bara steam and the major contributor to operation cost.
Since the cost of Natural gas is increasing day by day the cost of steam is also increasing day by day and hence it calls for alternative efficient technologies for generation of chilled water. Right now there are already three screw compressors are installed in utility block for chilled water generation.

Project Idea:
The project idea is to replace the VAM units with Screw compressor based vapor compression refrigeration systems which are more energy efficient then VAM units.

Potential Calculation:
Specific steam consumption for VAM is around 4.5 kg/TR.
Specific power consumption for screw compressor (chilled water temperature: 6.5°C) is around 0.75 kW/TR.
In DICO Plant total chilled water load is around 2048880 TR/a (7171 MWh/a) in year 2008.
In CYFO Plant total chilled water load is around 1123752 TR/a (3933 MWh/a) in year 2008.
Capacity of screw compressor for DICO plant is around 250 TR.
Capacity of screw compressor for CYFO plant is around 150 TR.
Total steam consumption of DICO & CYFO plant if VAM is operated is calculated and it is 14277 t/a and steam cost is 225574 €/a.
Total electrical power consumption of DICO & CYFO plant if screw compressor is operated is calculated and it is 2379 MWh/a and power cost is 174653 €/a.
Thus with screw compressor net saving in cost is 50921 €/a.

Investment Calculation:
Investment cost includes mainly the cost of new screw compressor, modification, electrification, insulation cost.
Investment cost is calculated and total investment estimated is approximately 107000 €/a.

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Constraints:
Usage of existing VAM units has to be found out or this idea should be implemented for old VAM.

Data Source / Previous Work:

Project Economics:

Utility Type	Energy Savings [MWh/a]	Cost Savings AP [€/a]	Cost Savings LP [€/a]	Carbon dioxide savings [t/a]	Quantity [unit per annum]	Quantity [unit per hour]	Units	Comments
Electricity	0.00	-174651	0	-944.64	-2379.44	-0.297	MWh	-
Steam 10 bar	0.00	225573	0	2684.04	14276.8	1.785	t	-
Total Savings:	**0**	**50923**	**0**	**1739.40**				

		A = feasible and profitable	**Rating:**
		B = likely feasible and profitable, needs further evaluation	B
Equipment investment [€]:	107000	C1 = technically (currently) not feasible but profitable	
Multiplier for total investment:	1	defined by customer; C2 = technically feasible but not profitable	
Total investment [€]:	107000	C3 = technically not feasible & not profitable	
Payback time [a]:	2.10	N = not rateable/nonsensical	
Annual operating time [hr/yr]:	8000	**Justification:**	
Affected product:	all Products		

Comments:

Project Description: | **Who** | **Until**

Project Execution by Customer:
Lead Responsibility: **Follow up:** **Completion until:**

Chilled Water Generation with VAM			
Steam Consumption for VAM	4.5 kg/TR		
Steam Cost	1030 INR/t		
Steam Cost	15.8 €/t		
Chilled Water Generation with Screw Compressor			
Specific power consumption of Screw Compressor	0.75 kW/TR		
Electricty price	73.4 €/a		
There are already three Screw Compressors already installed in utility blocks, presently Screw compressors are required for DICO & CYFO plant			
DICO Plant:			
DICO Plant Chilled Water Load	85370 TRDays/a	2048880 TR/a	7171 MWh/a
Assumed Operating hours	8000 hr		
DICO Plant load	256.11 TR		
Required Screw compressor capacity	250 TR		
Steam cost if Chilled water is generated with VAM			
Steam consumption with VAM	9220 t/a		
Steam Cost	145675 €/a		
Electricity Cost if chilled water generated with Screw Compressor			
Electrical power consumption with Screw Compressor	1536.66 MWh/a		
Power cost	112790.844 €/a		
CYFO Plant:			
CYFO Plant Chilled Water Load	46823 TRDays/a	1123752 TR/a	3933MWh/a
Assumed Operating hours	8000 hr		
CYFO Plant load	140 TR		
Required Screw compressor capacity	150 TR		
Steam cost if chilled water is generated with VAM			
Steam consumption with VAM	5057 t/a		
Steam Cost	79899 €/a		
Electricity cost if chilled water generated with Screw Compressor			
Electrical power consumption with Screw Compressor	843 MWh/a		
Power cost	61863 €/a		
Total Steam consumption of DICO & CYFO Plant	14277 t/a		
Steam consumption in t/hr	1.78 t/hr		
Steam cost for DICO & CYFO Plant	225574 €/a		
Total Electricity consumption for DICO & CYFO Plant	2379 MWh/hr		
Electricity consumption for DICO & CYFO Plant in MWh/hr	0.2974 MWh/hr		
Electricity Cost for DICO & CYFO Plant	174653 €/a		
Net saving in operation cost	50921 €/a		
Equipment cost calculation			
Cost of 250 TR Screw compressor	3700000 INR/a		
Cost of 150 TR Screw compressor	2500000 INR/a		
Pipin modification	250000 INR/a		
Insulation modification	250000 INR/a		
Electrical modification	250000 INR/a		
Civil modification	10000 INR/a		
Total equipment investment cost in INR	6960000 INR/a		
Total equipment investment cost in €/a	107077 €/a		
Say Total Investment cost is	107000 €/a		
Simple pay back time	2.1 Year		

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Example of process improvement

Initial Situation

- Reactor R268 is used for EDC solvent recovery, during this process agitator RPM of this reactor is maintained at 90 RPM.
- Rector R268 have motor of 22.4 KW and at 90 RPM it is consuming 18kW electrical power. Operating hours of reactor R268 in year-2008 are 6420 hr/a.

Approach

- Project idea is to reduce agitator RPM of reactor R268 and save electricity power consumption of agitator.
- RPM to be reduced in such a way that there is no adverse effect in process. Plant has already taken trail and RPM is reduced up to 67 RPM.

Results

- At 90 RPM power consumption of reactor R268 motor was 18 kW, 6420 operating hours in year 2008, total power consumption: 115.6 MWh/a.
- At 67 RPM power measured power consumption of motor is 11kW, operating hours 6420, total power consumption of is 70.62 MWh/a.
- Saving in power is around 45 MWh/a, which leads to cost saving of 3299 €/a.

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