



**RSC Speciality Chemicals Symposium -
'The Sustainability Challenge'
June 18-19 2008 at M.O.C. Munich**

How to Identify and Evaluate Sustainable Materials for the Chemical Industry

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 **BASF**
The Chemical Company

**BASF SE
Eco-Efficiency and SEEBALANCE**



BASF – The Chemical Company

- The world's leading chemical company
- Offers intelligent system solutions and high-value products for almost all industries
- Sales 2007: €57,951 million
- Income from operations (EBIT) 2007: €7,316 million
- Employees at year-end 2007: 95,175

How we achieve value-adding growth

We earn a premium on
our cost of capital

We help our customers
to be more successful



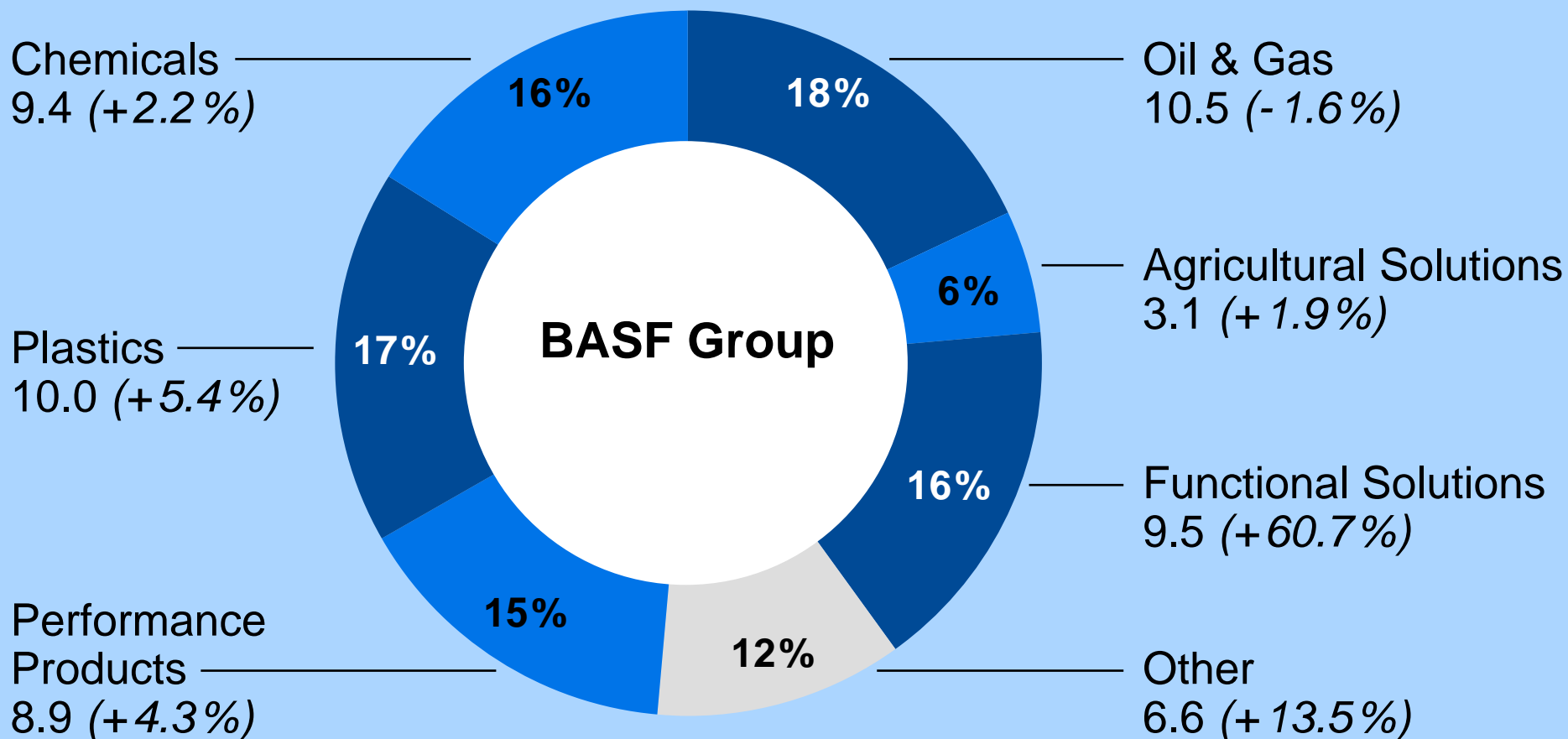
We form the best
team in industry

We ensure
sustainable development

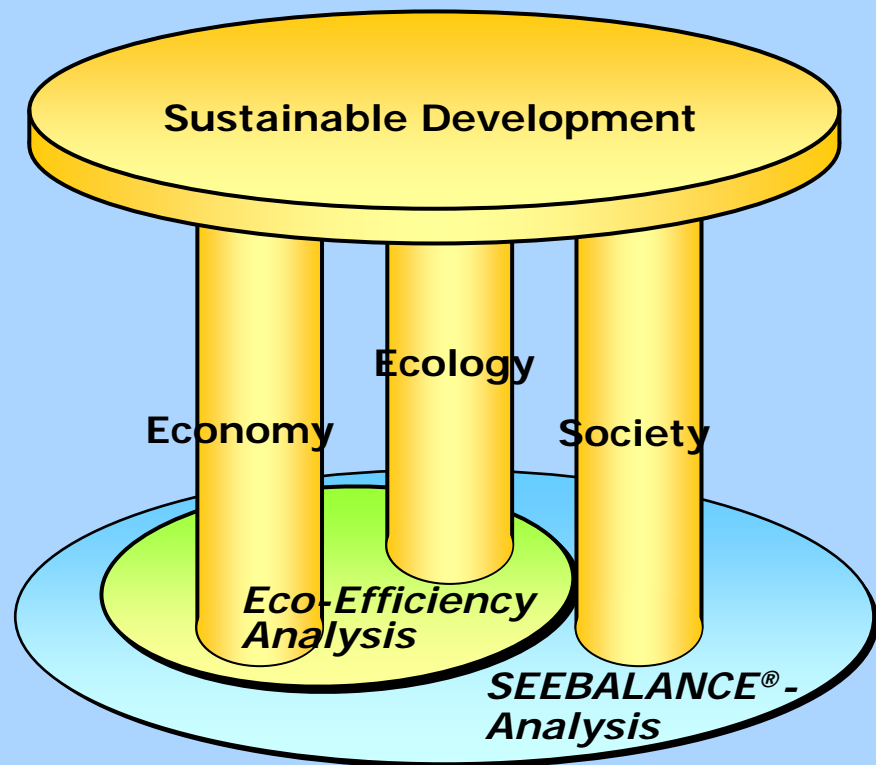
BASF Group: sales in 2007 (new segment structure)



billion € (change compared with previous year)



The Three Pillars of Sustainable Development is the Basis of the SEEBALANCE



- **Comprehensive assessment** of products and processes.
- **Ecology, Economy and Social figures** are given equal weight
- Products are analyzed with a „**Cradle-to-grave**“-approach from the **angle of the customer**.
- Different product alternatives for a defined „**User benefit**“ are assessed.
- The final result **compares the alternatives** with each other; leads to a ranking of different products or processes due to their sustainability.

- The BASF has an leading expertise in the world because
 - BASF is a company with a high level of competence in sustainability matters and professes itself to sustainable management
 - BASF runs four competence centers of Eco-Efficiency Analysis and finalized up to now more than 350 studies
 - the BASF-method has been validated by the TÜV in the year 2002
 - BASF cooperates trustfully with governmental departments, NGO's, the UN, the GTZ etc.



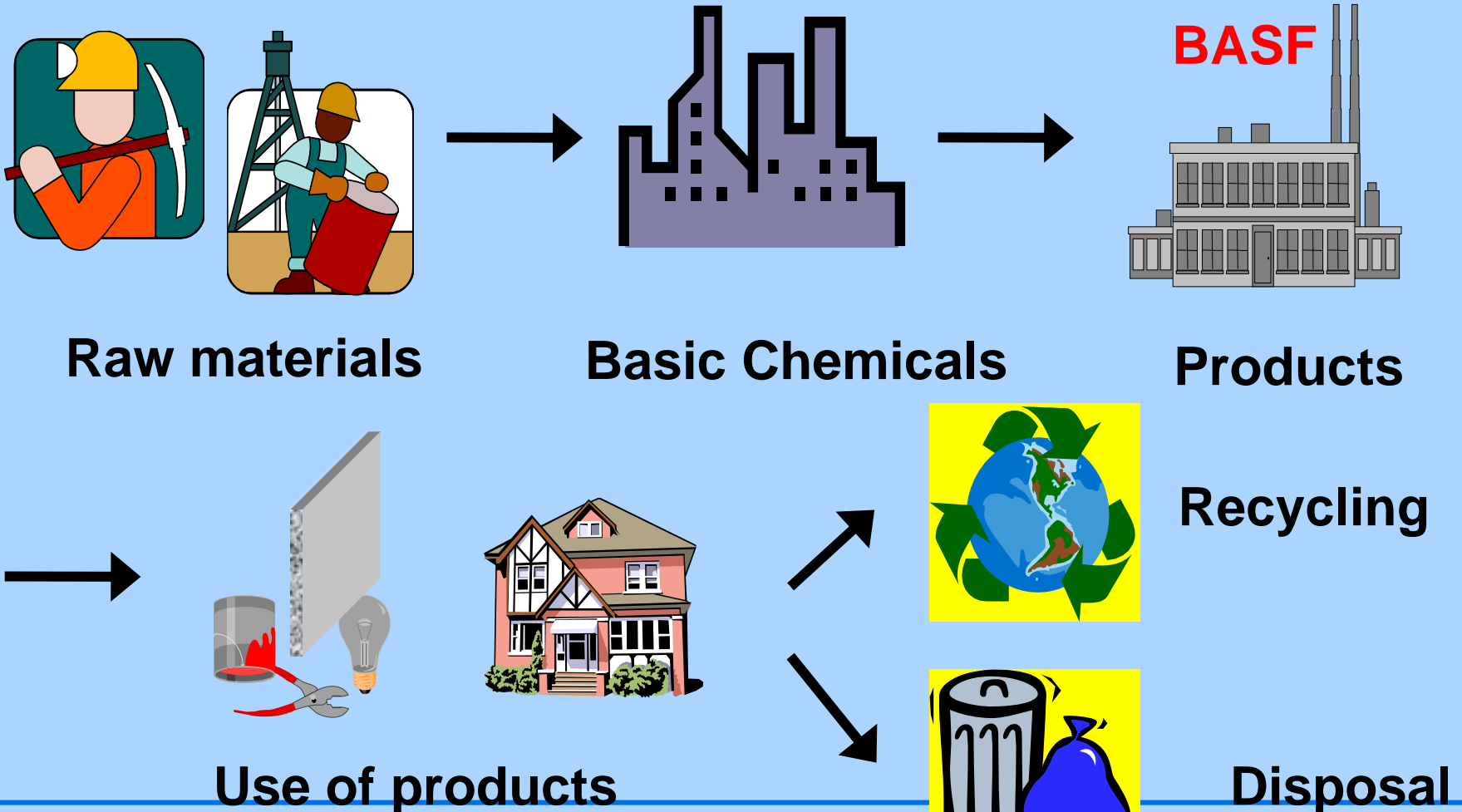
Validated

Eco-Efficiency
Analysis



Sustainability

The „cradle to grave“ approach



Example: Amino-Carboxylate Chelating Agents vs. Phosphates in Dish washing

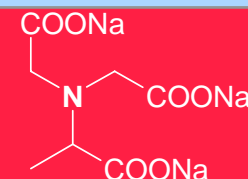
Customer Benefit

**Production,
use and disposal
of 100 ADW tabs (*)**

Alternatives

MGDA

Alanine, N,N-bis(carboxymethyl)-,
trisodium salt

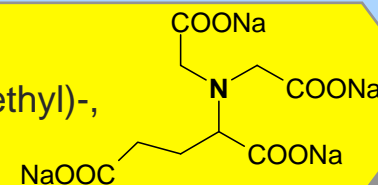


STPP

Sodium tripolyphosphate

GLDA

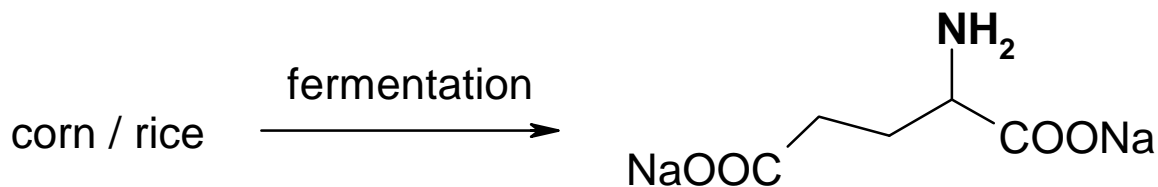
Glutamic acid, N,N-bis(carboxymethyl)-,
tetrasodium salt



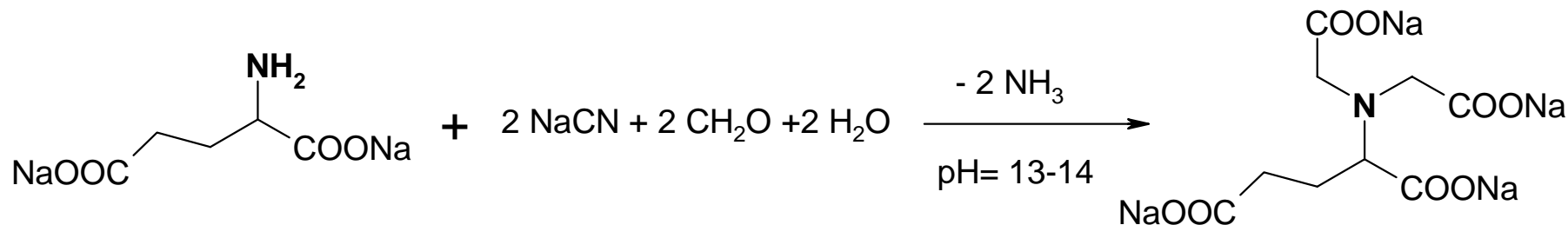
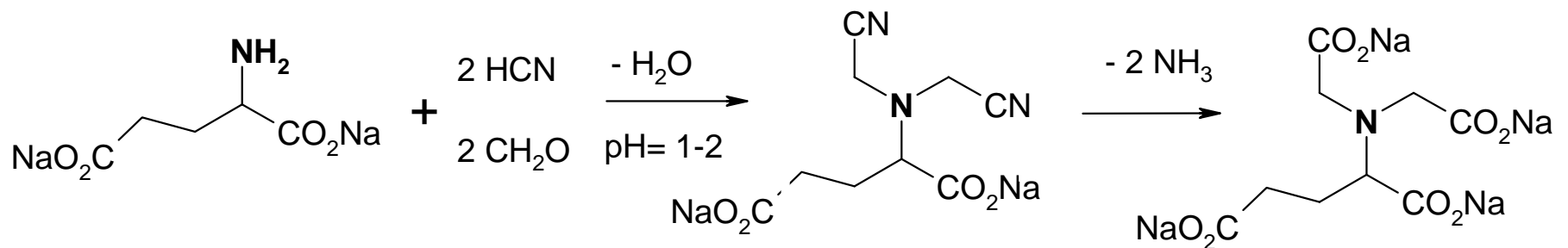
(*) Weight of tablets is fixed and equal for all alternatives, this is achieved by addition of biobased sodium citrate and sodium sulphate

Definition of Chemical Processes to be Compared; Example GLDA, biobased

■ Fermentation

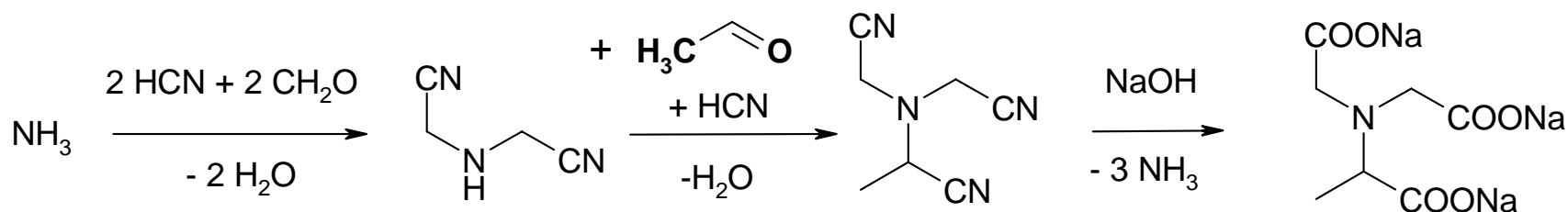
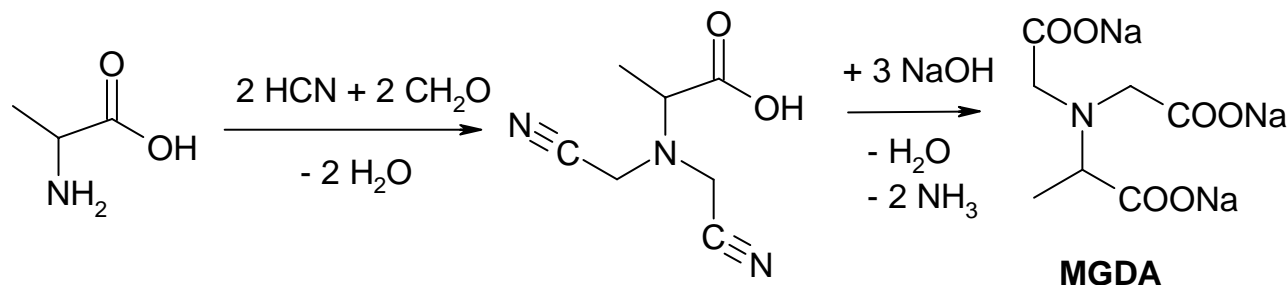


■ Acid or basic Strecker-Synthesis (Ullmann, DE 4211713)

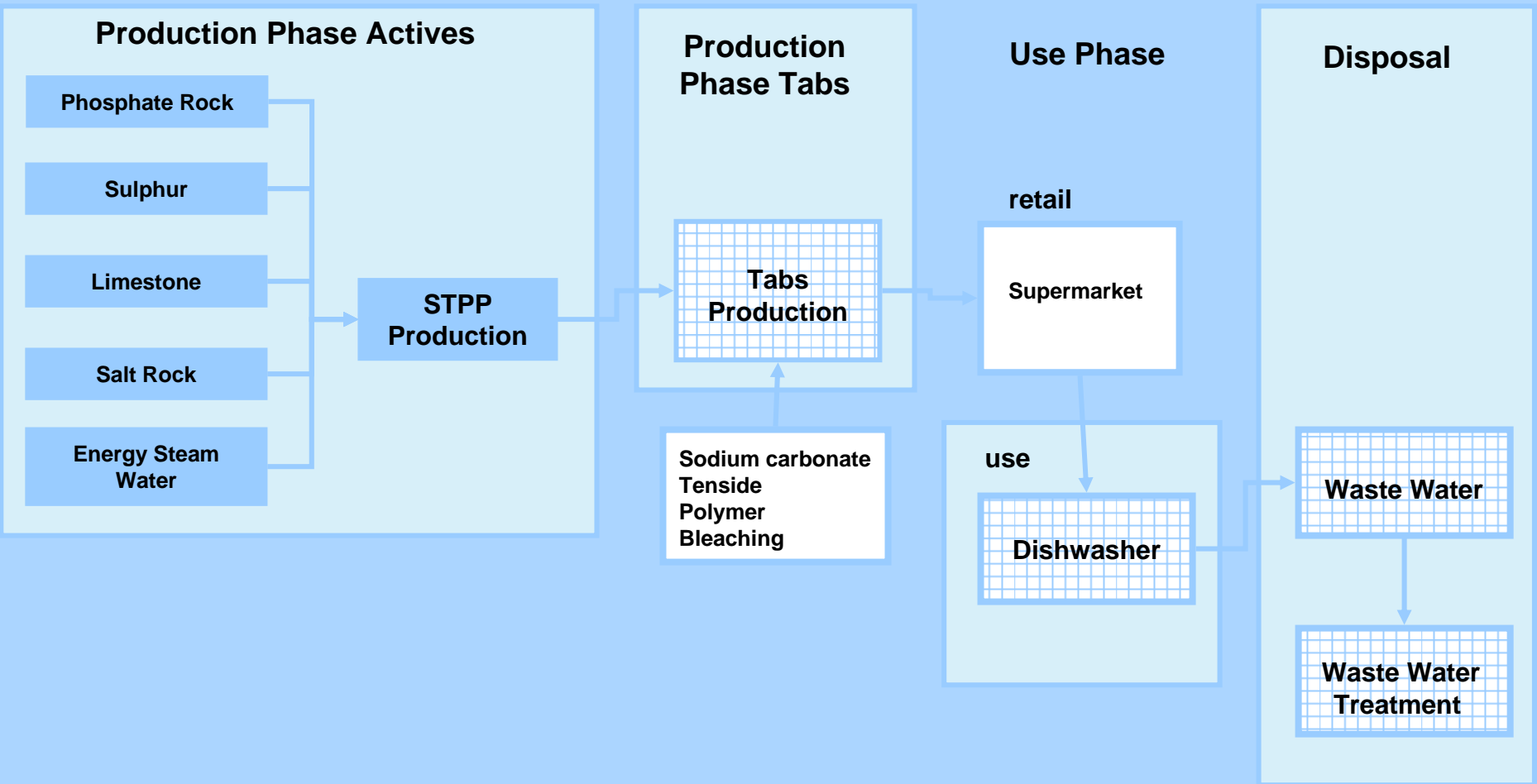


Definition of Chemical Processes to be Compared; Example MGDA

- Acid or basic Strecker synthesis
- two alternative starting materials can be used (EP 547782)



Definition of System Boundaries over the whole life cycle: Example Sodiumtripolyphosphate



Costs Calculation Based on Selling Prices of Ingredients

For costs calculation normal average market prices are assumed

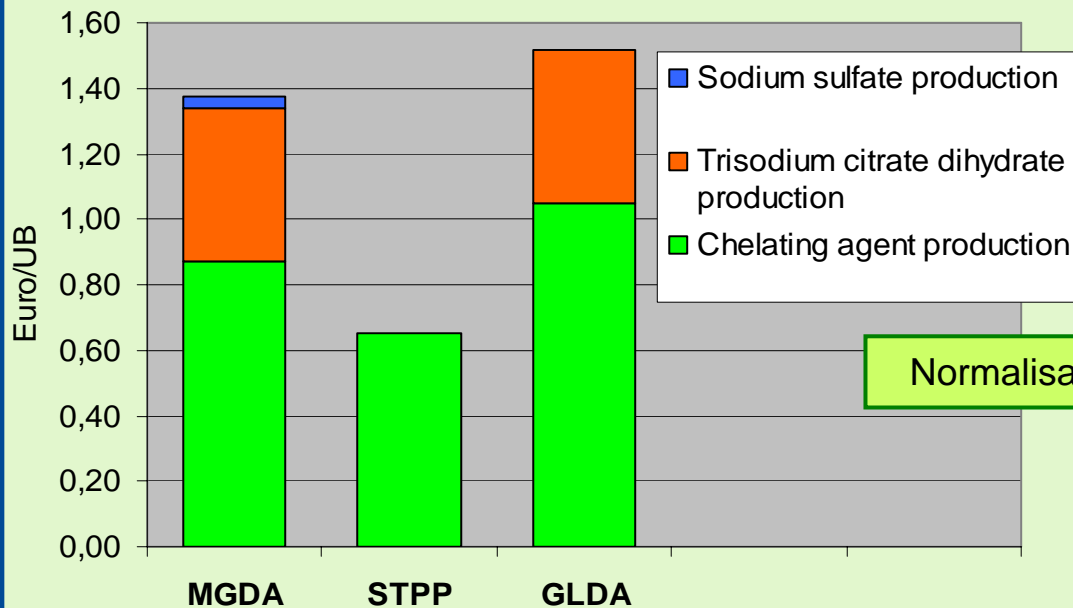
MGDA



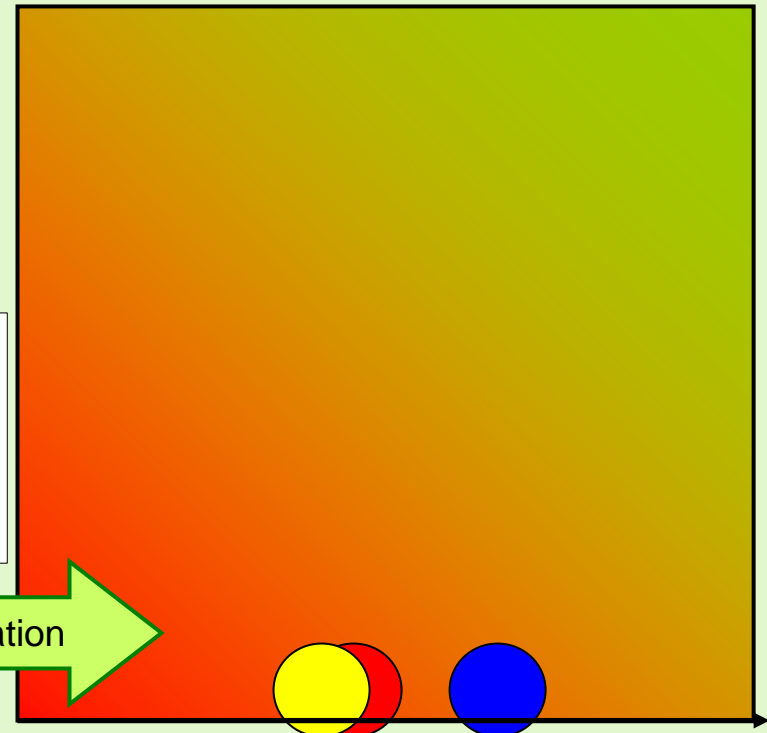
STPP



GLDA



Normalisation

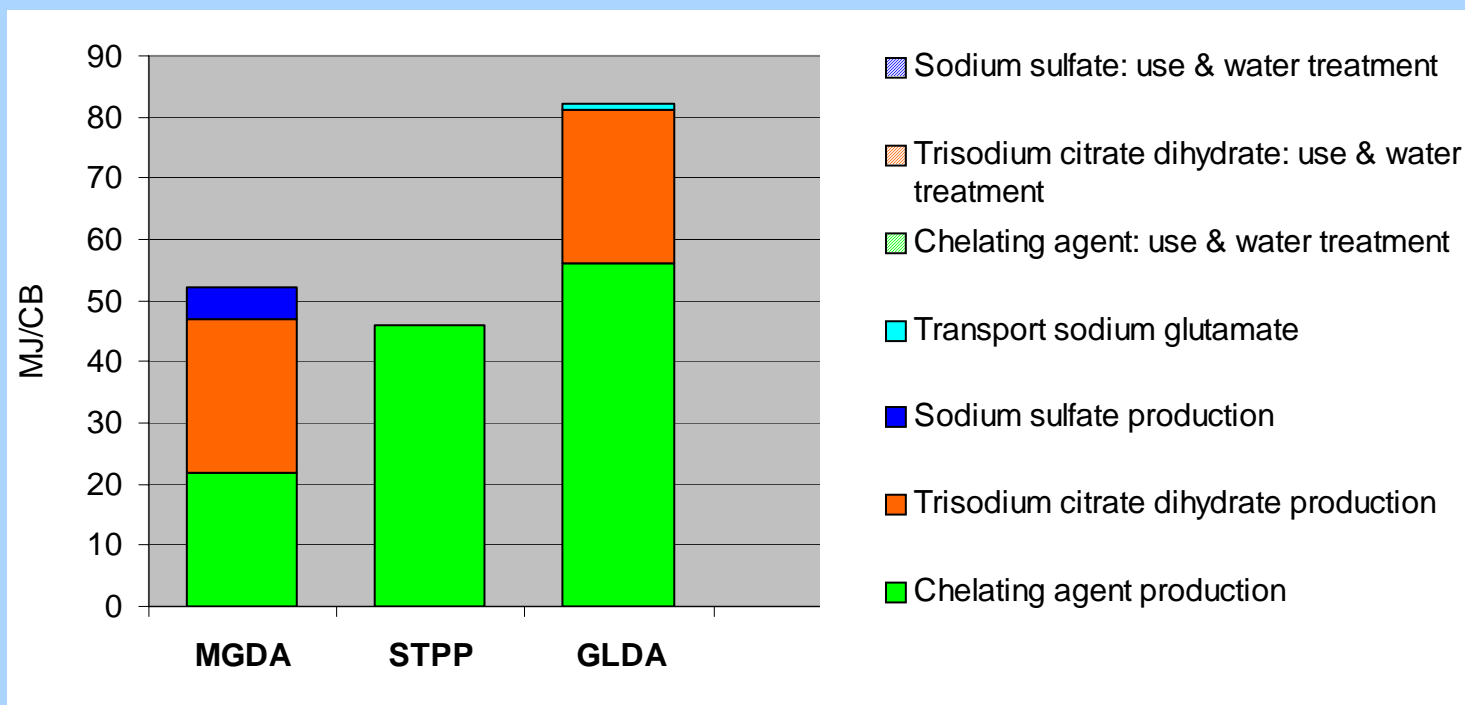


costs (per customer benefit) normalised

Results

Energy Consumption

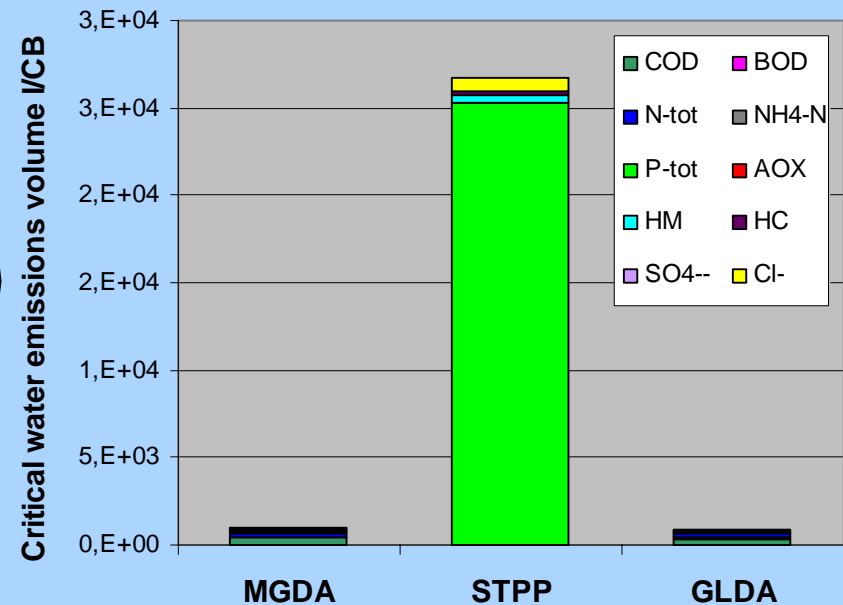
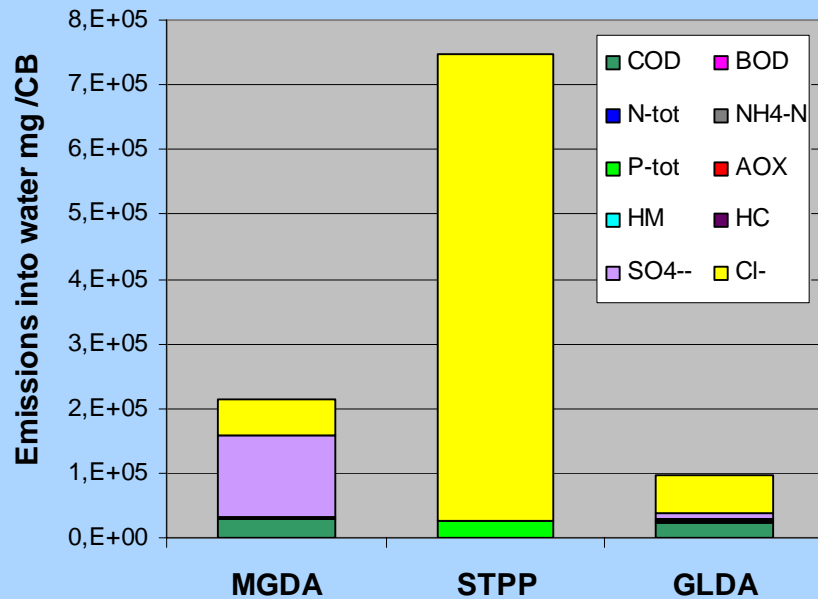
- Energy necessary for production and use of the alternatives (cradle to grave)



Results

Water Emissions: From Emissions to Impact

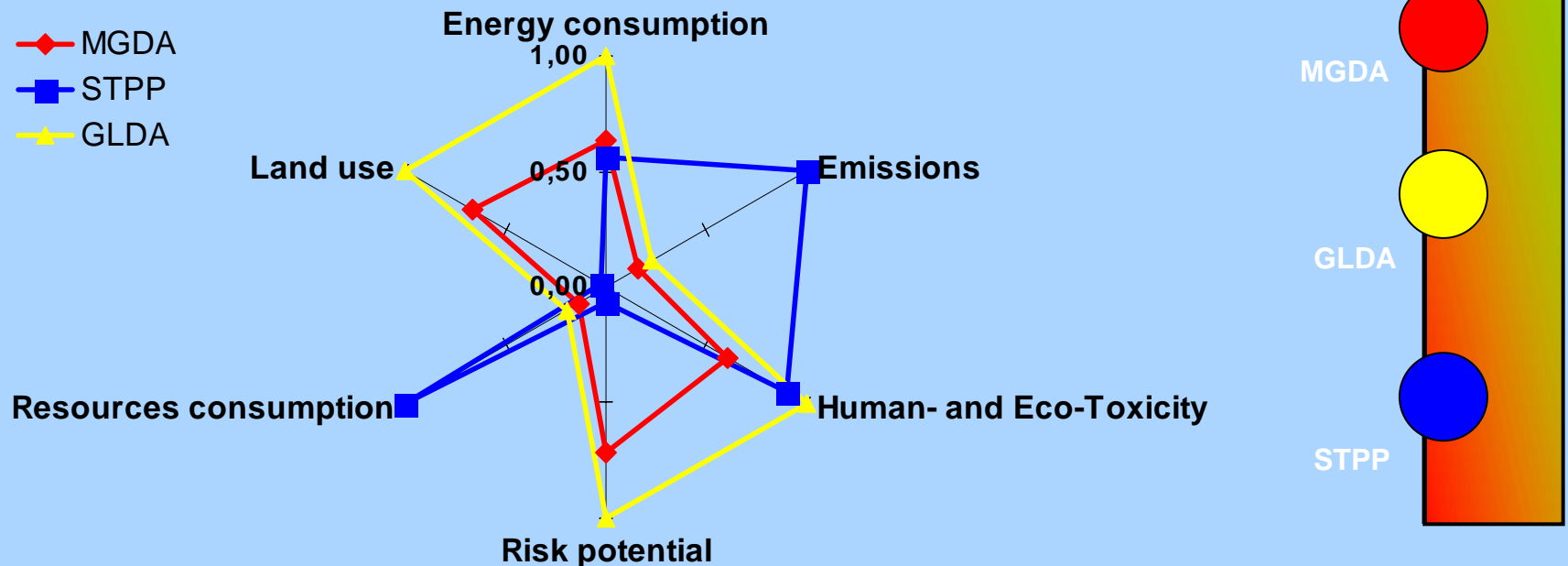
- The impact of water emissions is **evaluated** by using the critical volumes approach. Emissions are calculated by the corresponding MEC values (maximum emission concentration) based on threshold limits
- STPP has the highest impact due to phosphate emissions into aquatic system (after waste water treatment)



Results

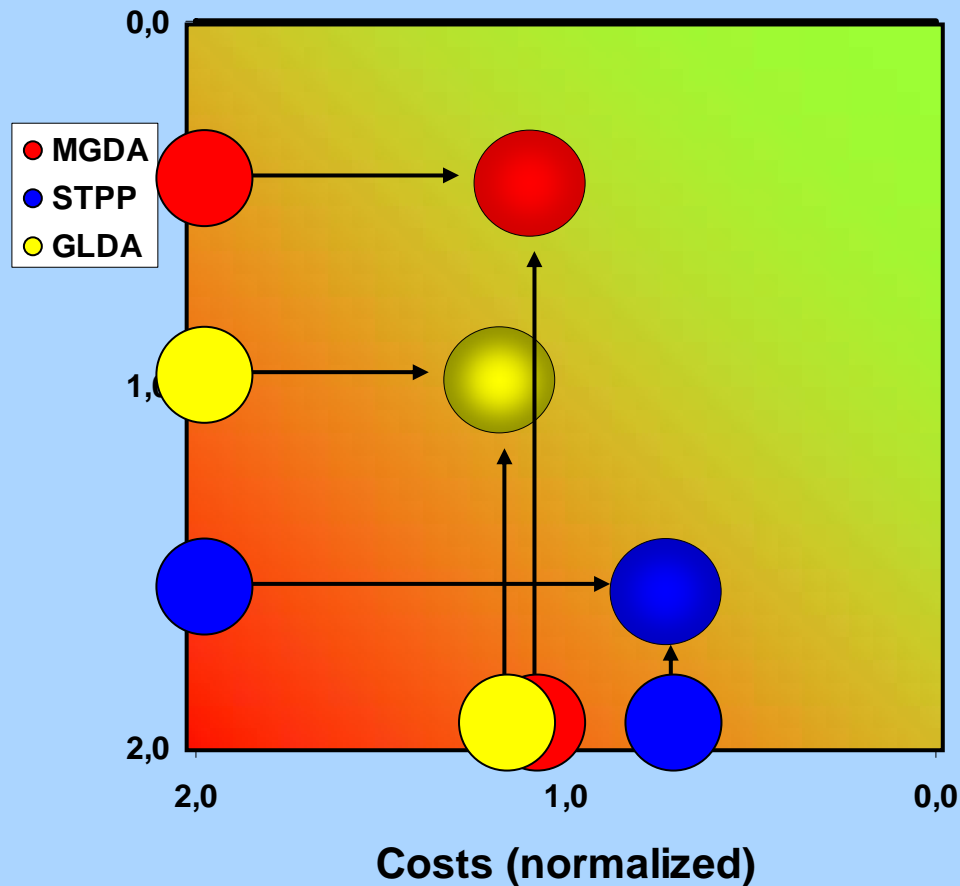
Ecological Fingerprint

- Environmental impacts are calculated for six categories
- The aggregated environmental impacts are converted into one score for environmental impact via weighting and normalization of data



Results

Eco-Efficiency Portfolio



Environmental Impact (normalized)

- Amino-carboxylate chelating agents have lower environmental impact compared to STPP
- The biobased alternative ranks in the middle. So, using biobased materials is not an optimum

How to use 1 ha of land most sustainably?

To make Biodiesel?

To produce bioliquids?

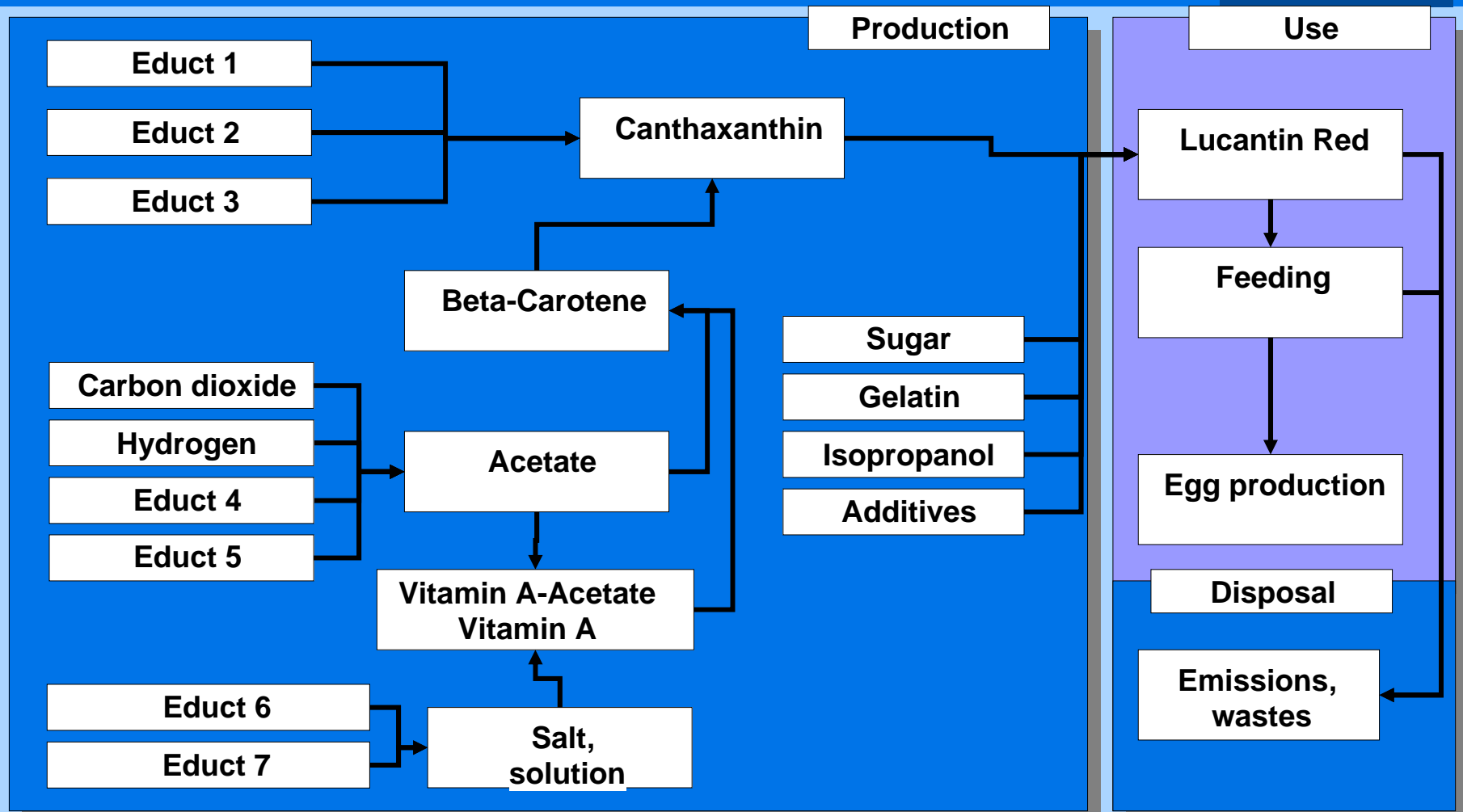
To produce food?

To produce chemicals?

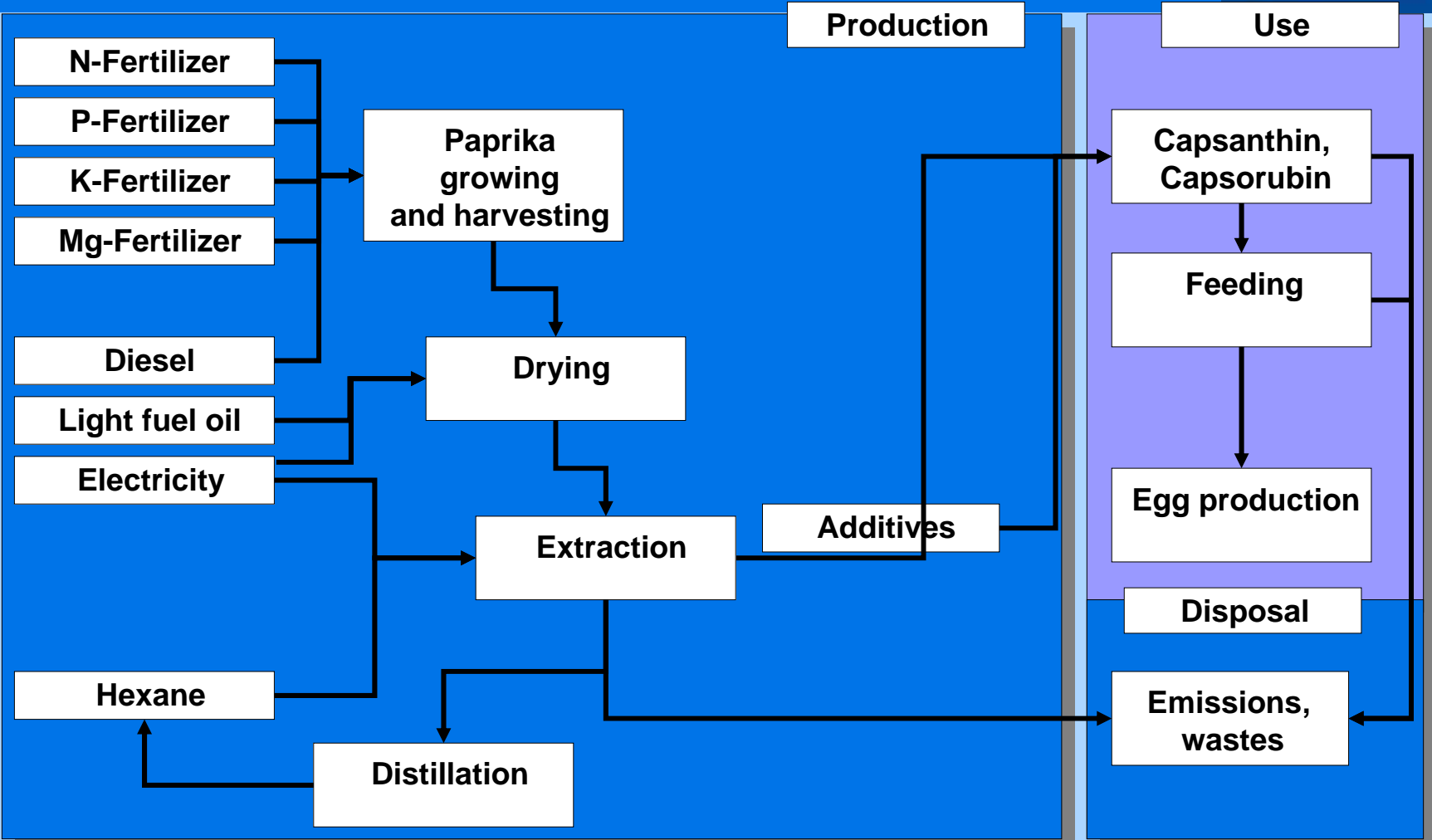
To produce electricity?

To feed animals?

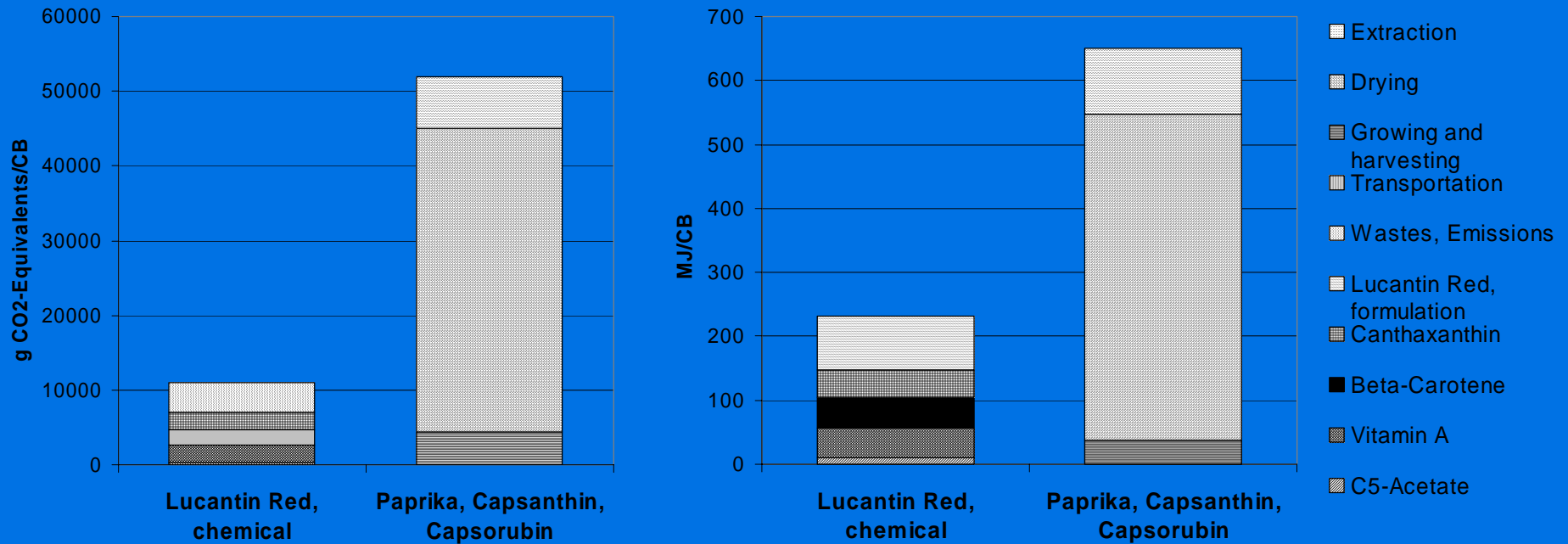
System Boundaries: Lucantin Red, Canthaxanthin, chemical



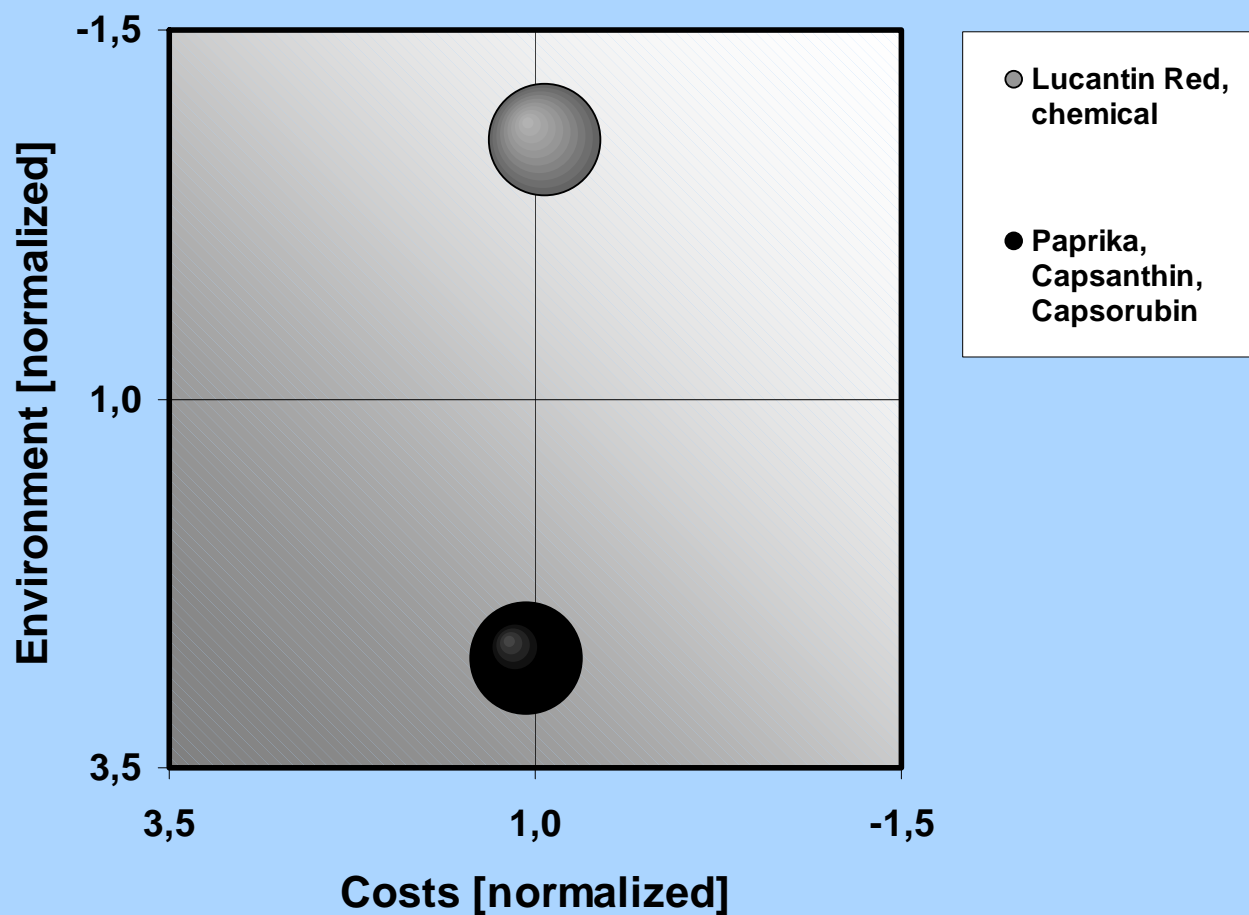
System Boundaries: Paprika, Capsanthin and Capsorubin



Carbon dioxide and energy consumption



The chemical process is the most eco-efficient alternative!



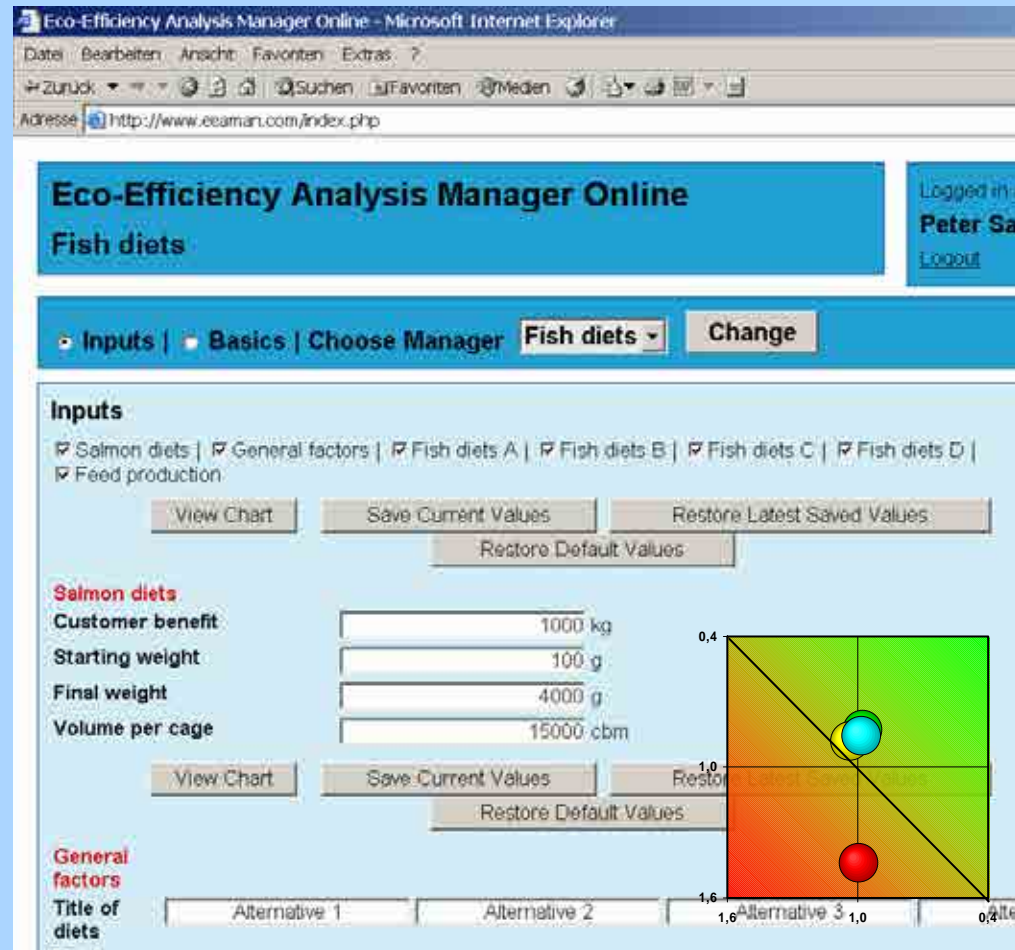
Internet Manager for scenario analysis

Eco-efficiency analysis by our customers



- Example: Fish farming industry and scientific institutes in Scandinavia
 - **Internet portal** for performance of independent eco-efficiency analyses
 - Feed composition can be selected from 30 ingredients for various fish species
- The eco-efficiency manager allows customers to optimize their formulas independently

www.eeaman.com



Using soy bean oil for fermentation

Vitamin B₂



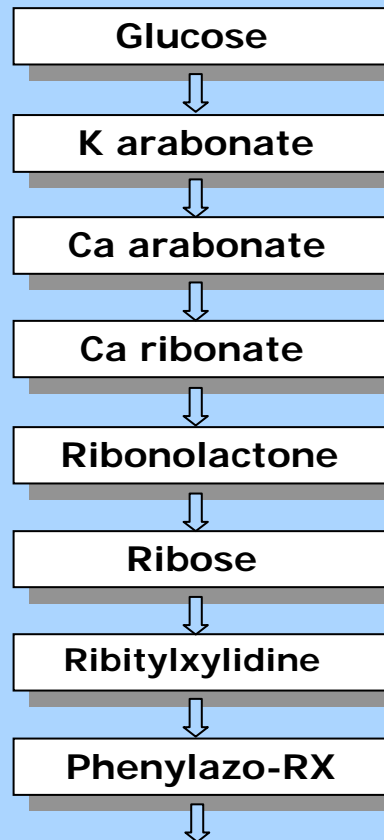
Nutrition

Fermentation

Soybean oil

+ Energy
+ Water
+ ...

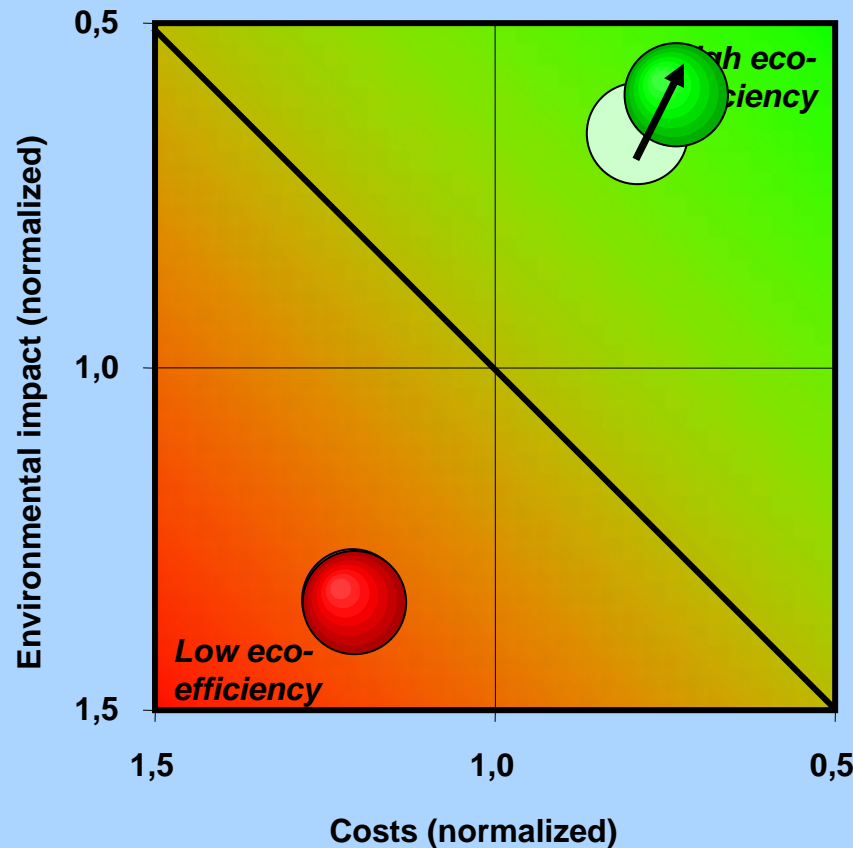
Chemical Process



Vitamin B₂

Portfolio - Scenario: 20% Increase of the Yield in the Biotechnological Process

Customer-related-benefit: 100 kg Vitamin B₂ as supplement for feed



- BASF fermentativ vitamin B₂
- Chemical process vitamin B₂
- Base Case biotech.

An increase of the yield improves the eco-efficiency of the biotechnological process.

ENVIRONMENT: DECREASING THE FOOTPRINT, Project of EuropaBio for Policy Making



Source: EuropaBio, McKinsey, BASF 2002

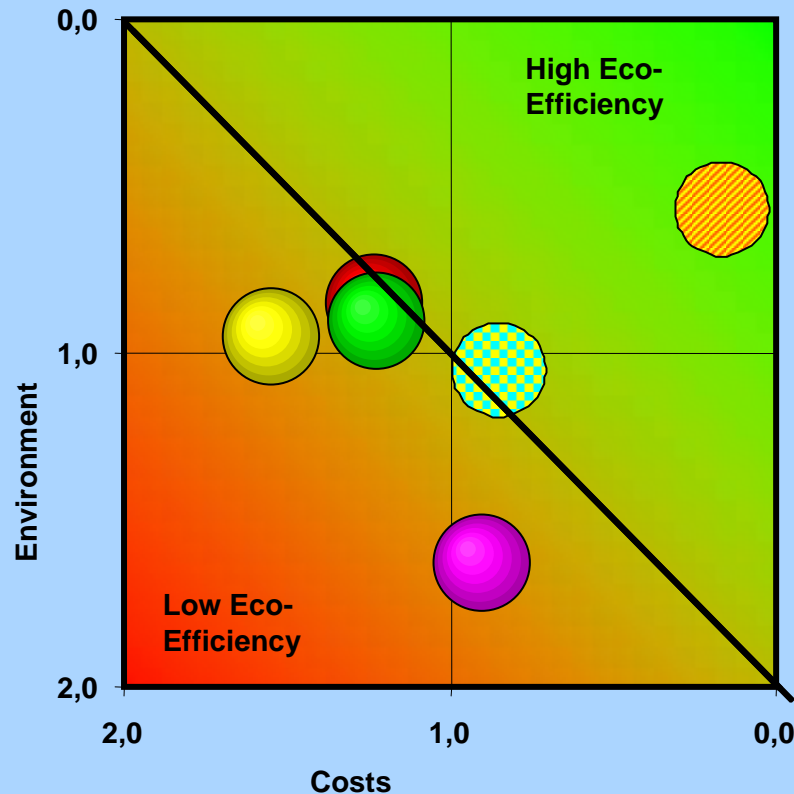
Case studies

	Environmental impact			Economic impact
	Energy efficiency	Raw materials consumption	CO ₂ emissions	Production costs
Vitamin B2 (BASF)	+	++	+	+
Antibiotic Cephalexin (DSM)	++	++	+	+
Scouring enzyme (Novozymes)	+	+	0	+
NatureWorks SM (Cargill Dow)	+	++	++	0
Sorona [®] (DuPont)	+	++	+	+
Ethylene from biomass (future scen)	0	++	++	--

Eco-Efficiency Analysis takes an overall view

Customer

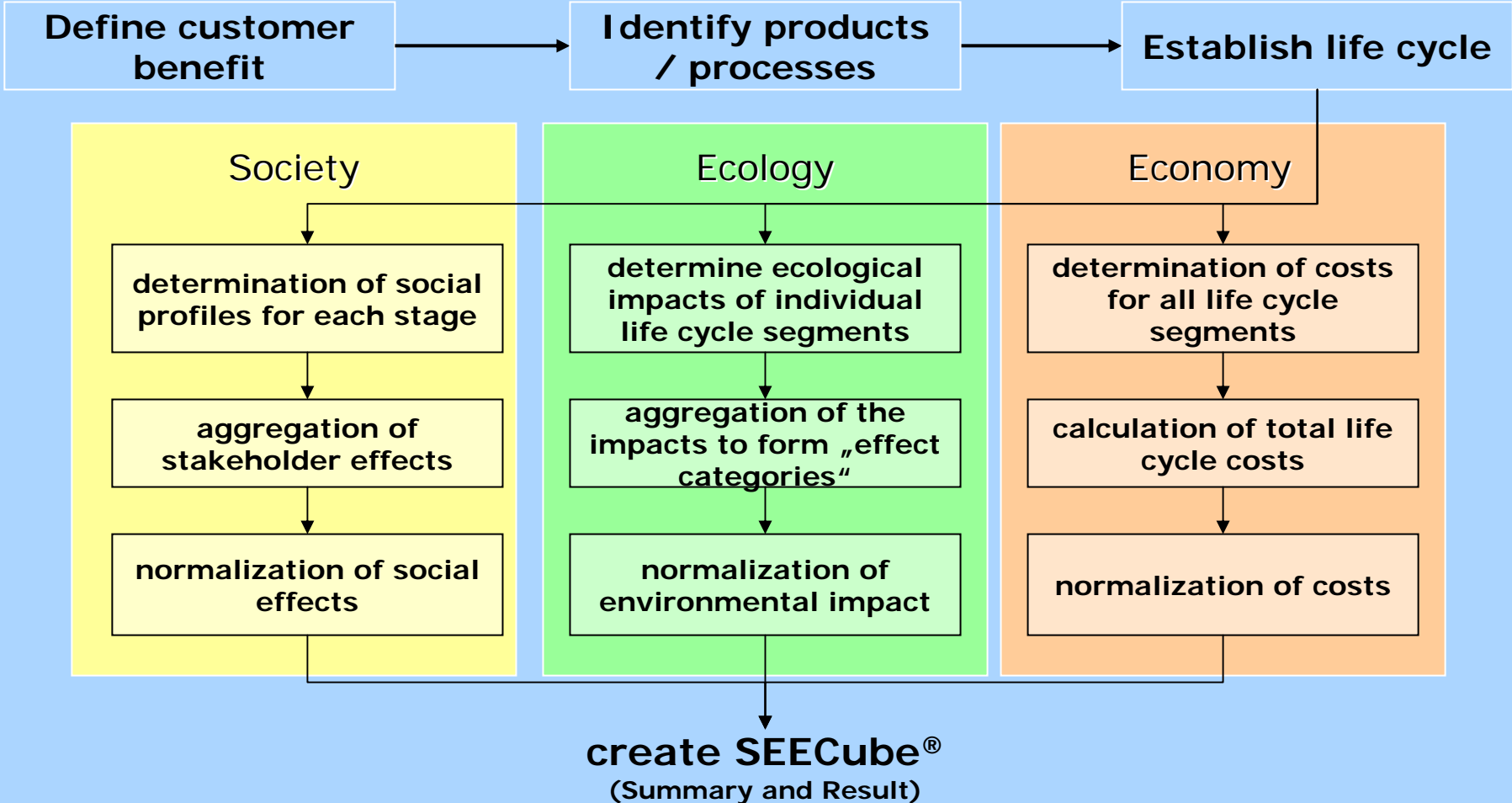
benefit: Using 1 ha of land for 10 years



- Biodiesel (RME) or. Diesel
- Biomass to Liquid
- Electricity from biomass
- Vitamin B₂ by fermentation
- Extraction of pigments from plants
- Bioethanol

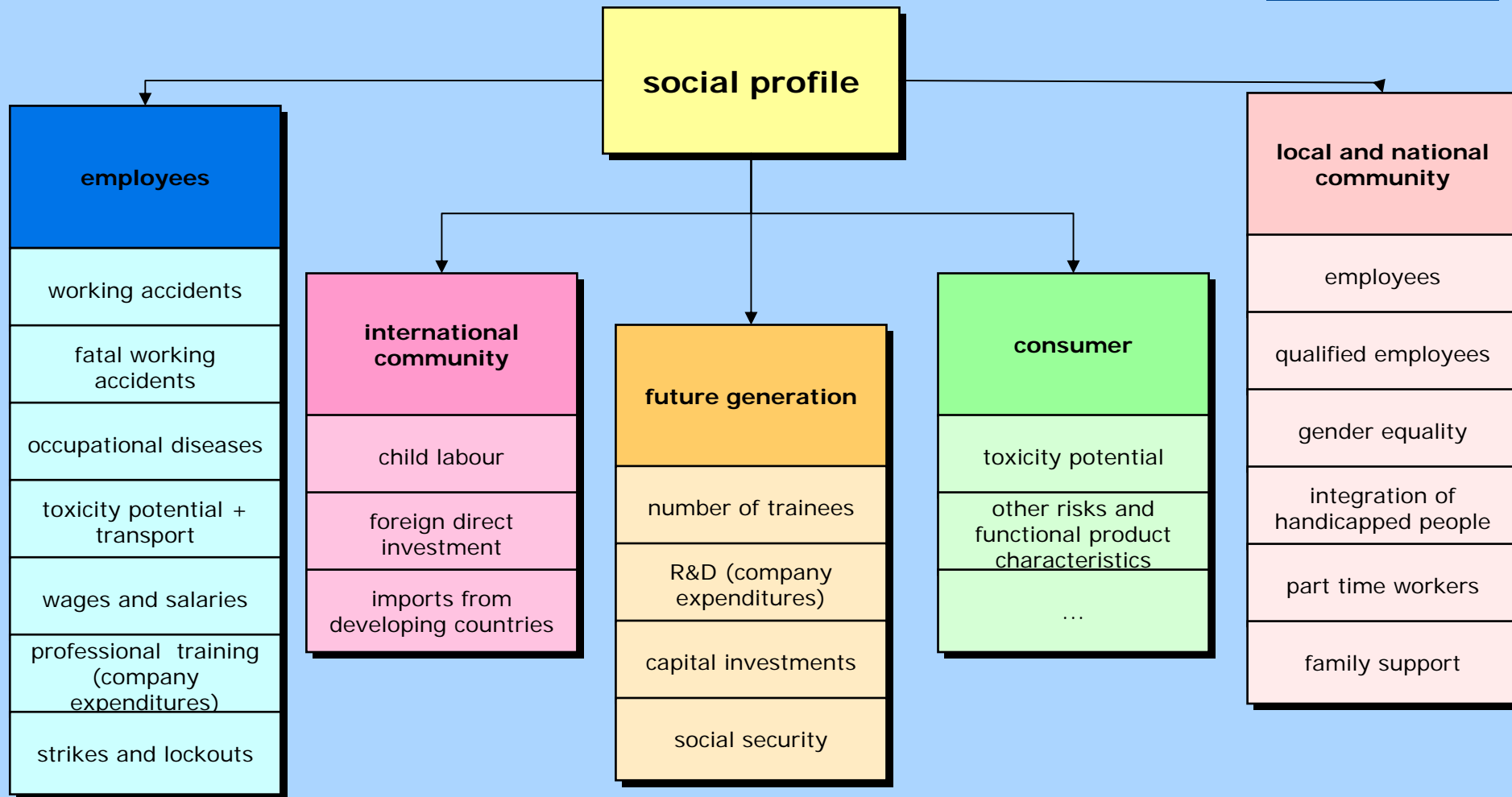
Introduction of SEEBALANCE

The total sustainability approach



SEEBALANCE®

What is a Social Profile?



Example: Using a chemical, calculation with NACE-codes

Sodiumhydroxide
Stakeholder 4, Chem. Ind.

Using 1 t

Employees
worker / 1000t

Qualification
workeryears /
1000t

2-Digits	24	Production of chemical goods
3-Digits	24.1	Manufacture of basic chemicals
4-Digits	24.13	Manufacture of other inorganic basic chemicals

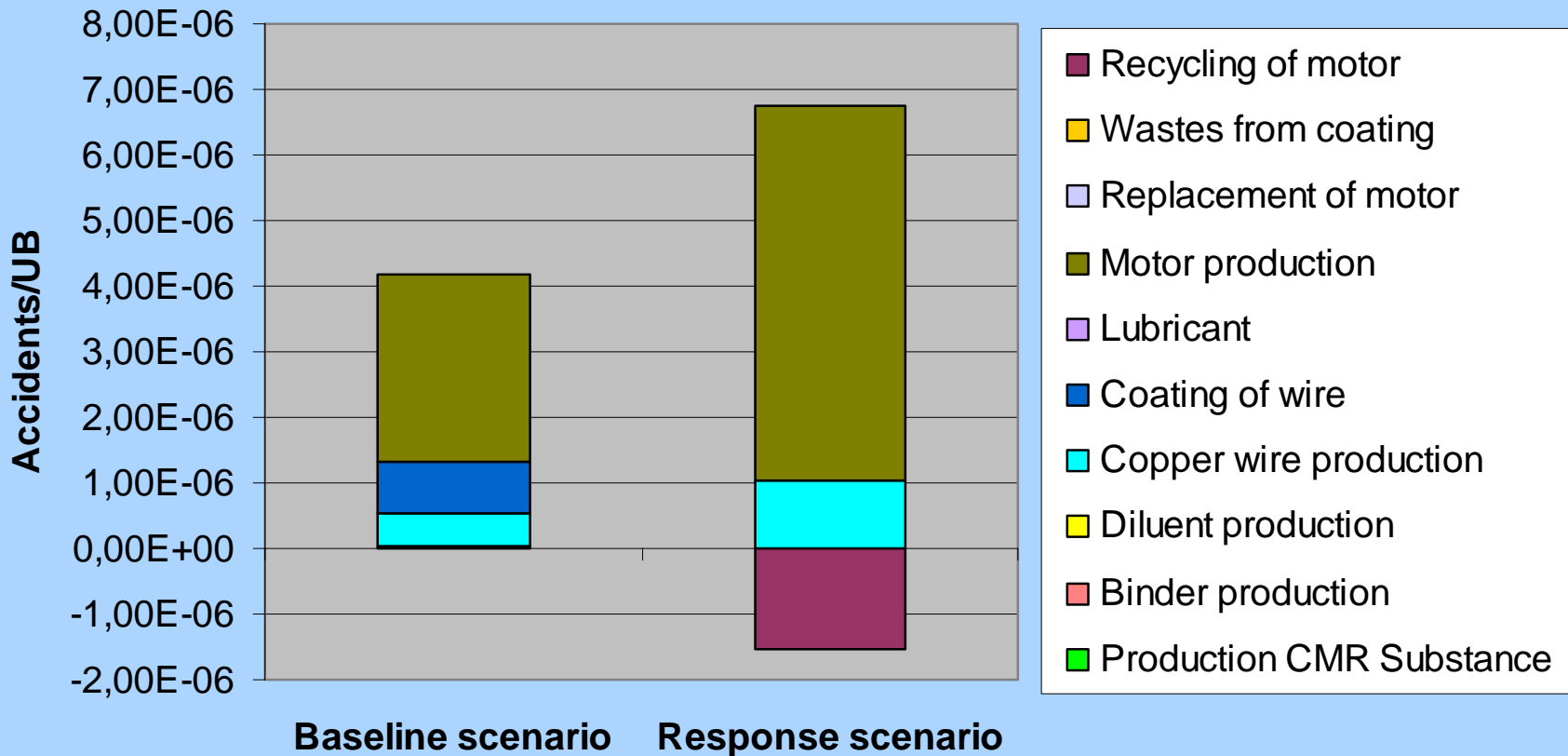
0.00115

2.638

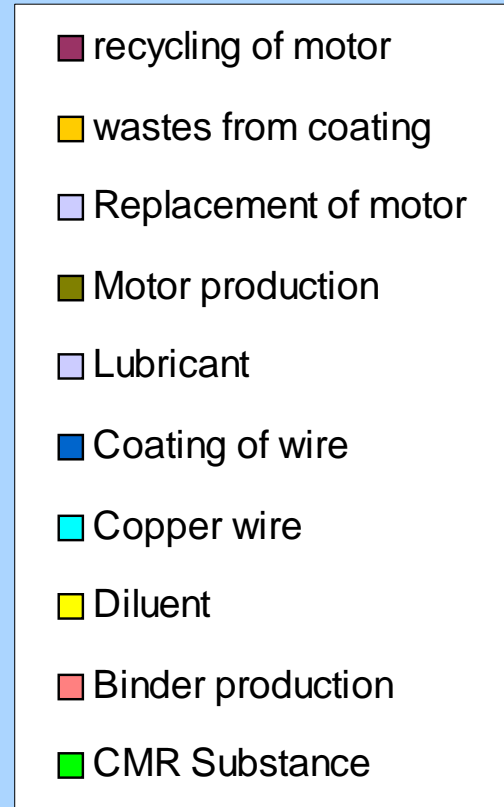
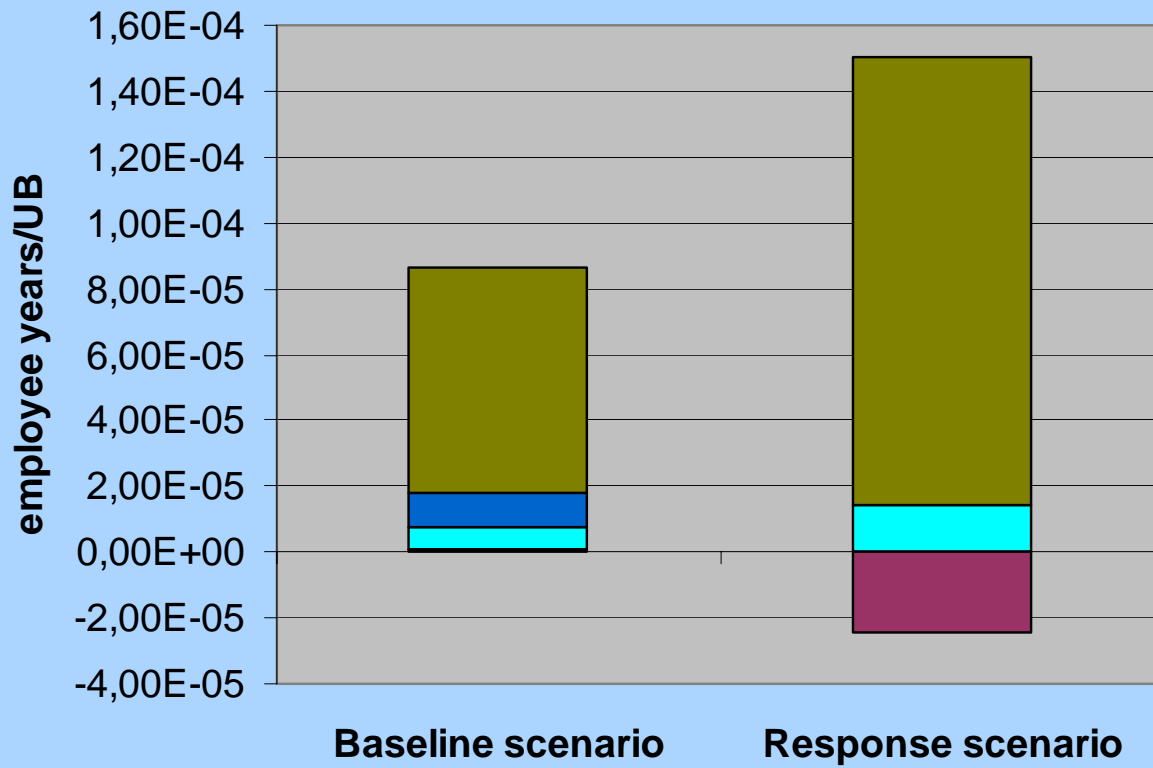
0.00000115

0.002638

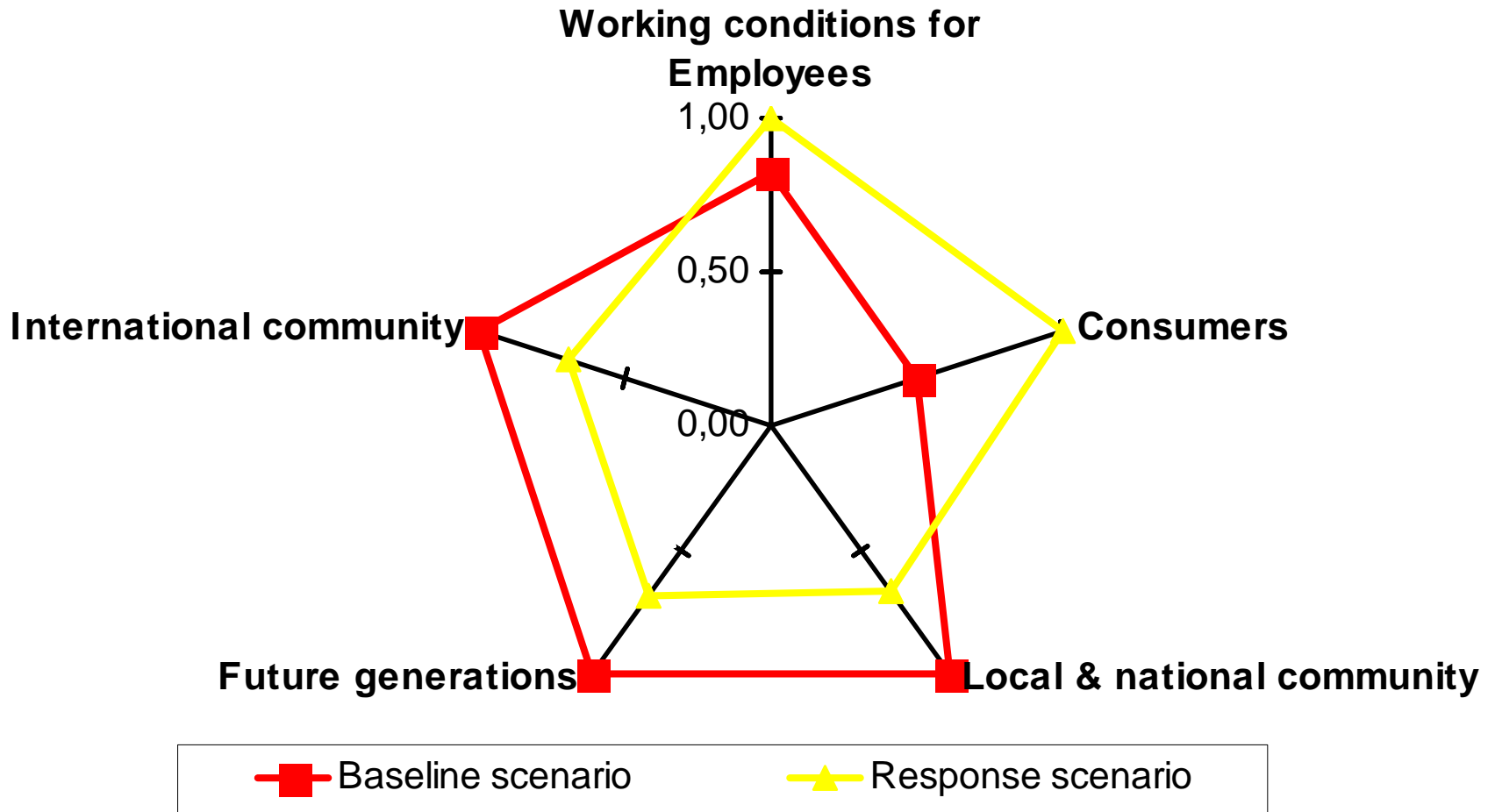
Accidents



Employment rates

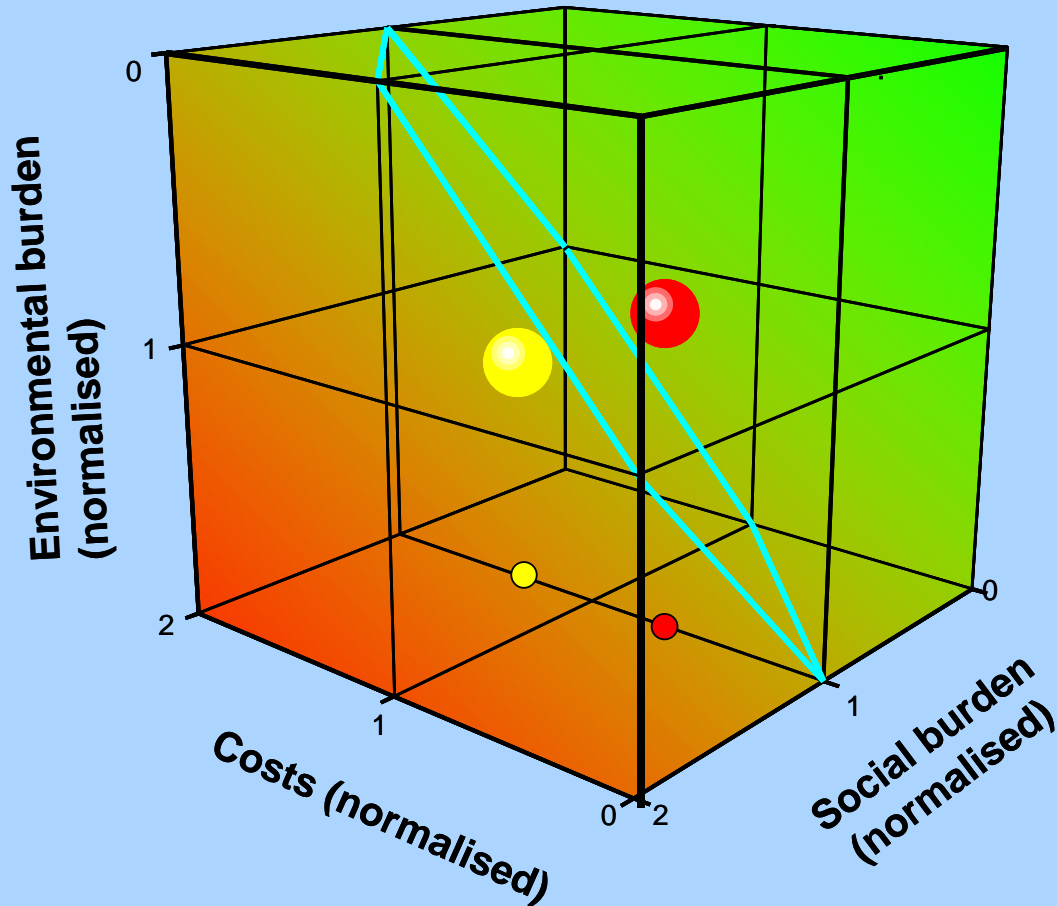


Social Fingerprints



SEEBALANCE® - REACH; RIP 3.9

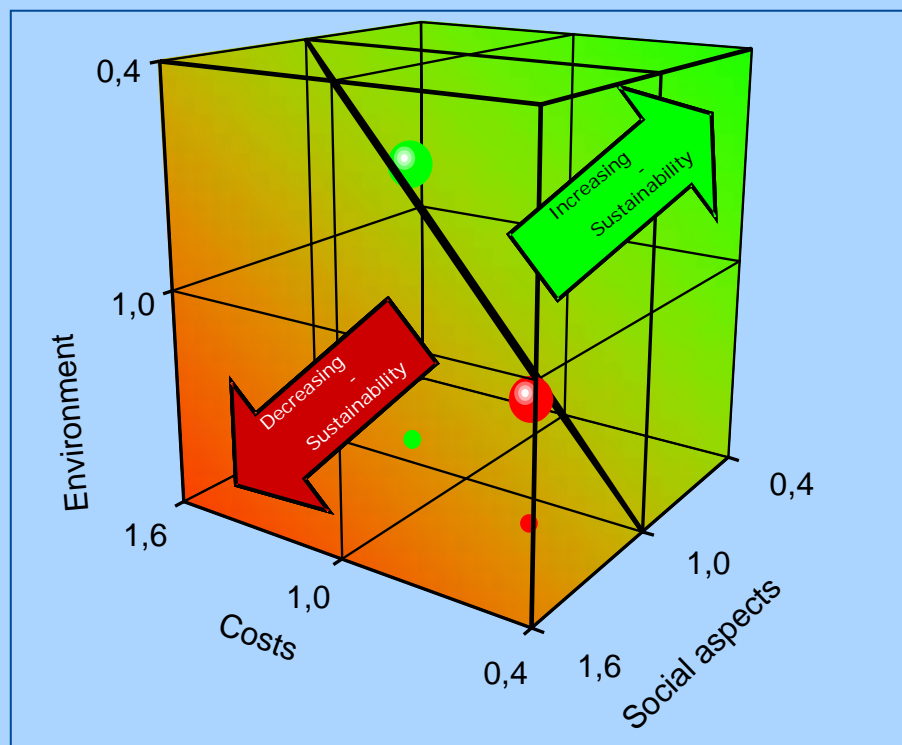
SEE-cube: Advantages for the Baseline Scenario



● Baseline Scenario ● Response Scenario

SEEBALANCE® Results for Biodiesel

User benefit:
Production of
1kg of
4-methoxy-
acetophenon



- Diesel
- zeolite process
- Fe(HSO₄)₃ process
- Indiumtriflat process

**Biodiesel is slightly
more eco-efficient**

How does BASF use the Eco-efficiency Analysis and SEEbalance?

Strategic Decisions

- Investment decisions
- Technology decisions
- Site decisions
- Evaluate product portfolio

Marketing, Customers

- Demonstration of product advantages
- Improved customer relations
- Product Differentiation
- Better understand competitive advantages

Research and development

- Quantification of the most important factors
- Drive sustainable products and processes
- Drive production/process improvements

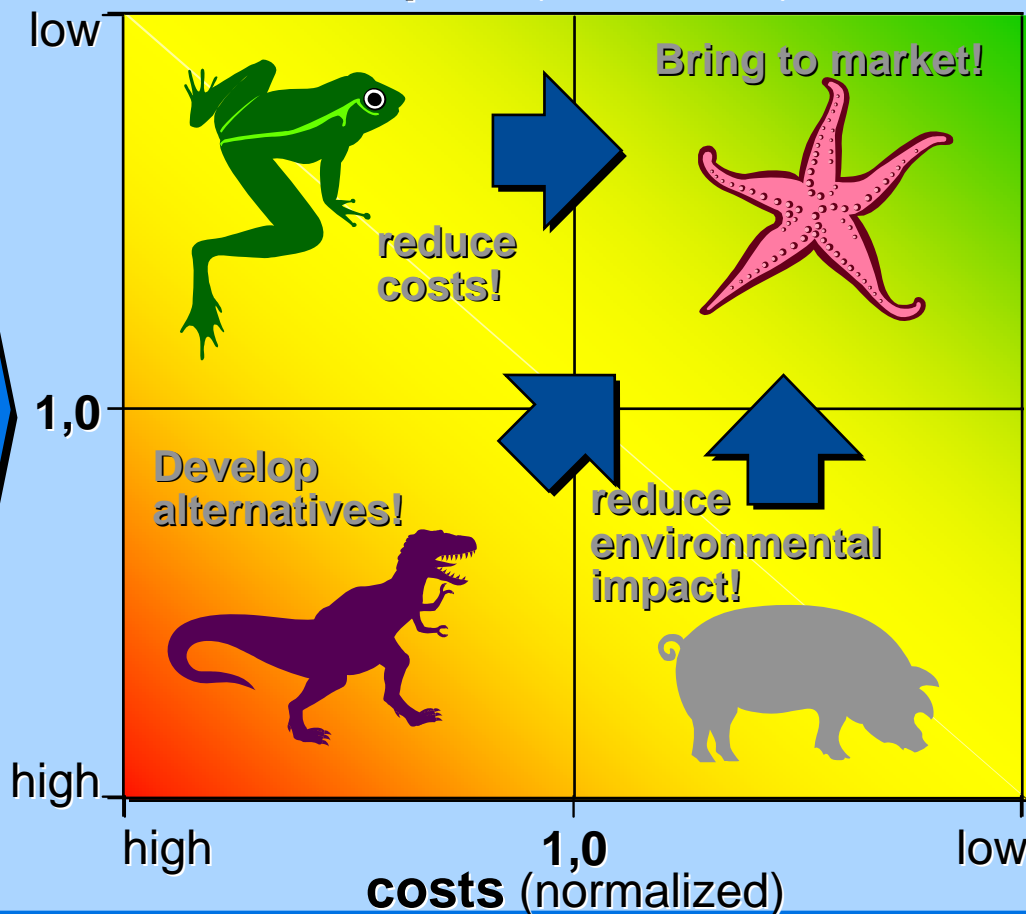
Stakeholder and Government Dialogue

- Communication with authorities
- Demonstration of Sustainability
- Government “approvals”

Consequences of Eco-Efficiency Analyses

Depending on the position of the analysed product, different strategical recommendations are given.

Environmental Impact (normalized)



The competence center of product safety within BASF- your partner in questions of:

- **Eco-Efficiency Analysis, LCA**
- **Sustainability, SEEBALANCE**
- **Eco-Efficiency Internet managing tools**
- **Eco-Efficiency Label**
- **Business Development**
- **REACH**
- **Publications, conferences, Internet-Information**



Our Homepage: (<http://www.oekoeffizienzanalyse.de/>)

Office for Europe, Asia:

Office for NAFTA:

Office in Brazil,

South America:

BASF SE, Ludwigshafen, Germany

BASF Corporation, Florham Park, New Jersey, USA;

BASF Corporation, Wyandotte, Michigan, USA;

Espaco Eco foundation and BASF S.A., Sao Bernardo, SP.,

Brazil

Successful research and sustainable development of new processes

Trends and challenges in sustainable product development

Eco-Efficiency Analysis
And
SEEBALANCE

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The Chemical Company

