

# Sustainability evaluation at BASF and its application for research projects

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# Our purpose

We create chemistry  
for a sustainable future



# Sustainable Innovations








## Growth and Technology Fields

Resources, Environment & Climate

Food & Nutrition

Quality of life

### Chemistry as enabler

Customer industries							
	Transportation	Construction	Consumer Goods	Health & Nutrition	Electronics	Agriculture	Energy & Resources
Growth fields*	Batteries	Heat management	Enzymes	Medical	Organic Electronics	Plant biotechnology	Energy management
	Leightweight composites					Functional crop care	Rare earth metals recycling
	Heat management						Wind energy
							Water solutions
Technology fields	Raw material change						
	Materials, systems & nanotechnology						
			White biotechnology				

\*including growth fields still under evaluation

# Technology Field

## White Biotechnology

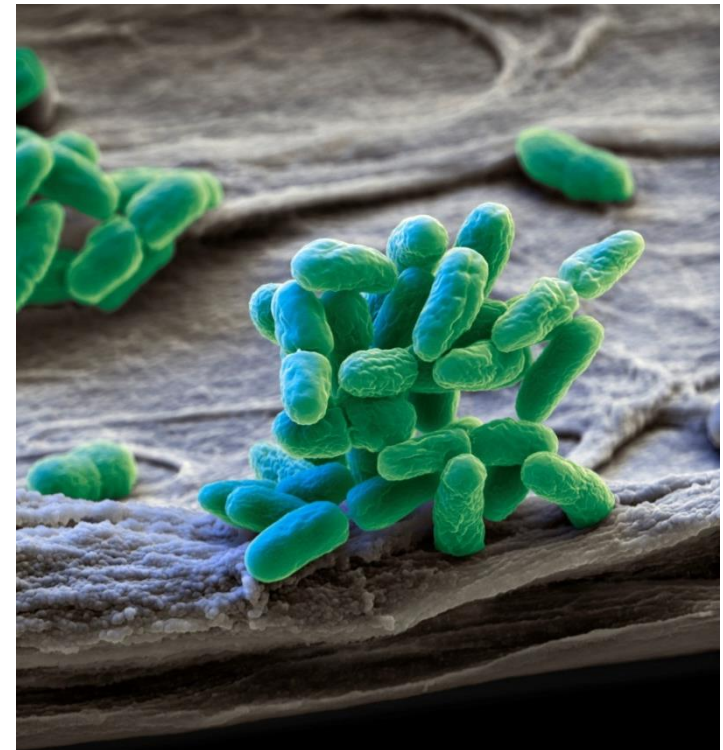
We use nature's synthetic power to develop innovative and resource-conserving solutions for our customers.

### Research focus

- Development of new products and processes for a wide range of industries
- Sustainable production and increased use of renewable resources
- Identification and optimization of production organisms such as micro-algae and fungi, development of novel enzymes and proteins

### Examples of existing activities

- Food and animal nutrition: Vitamin B<sub>2</sub>, thermostable enzymes (phytase, xylanase, glucanase)
- Enhanced oil recovery: biopolymer schizophyllan
- Bulk chemicals: biobased succinic acid

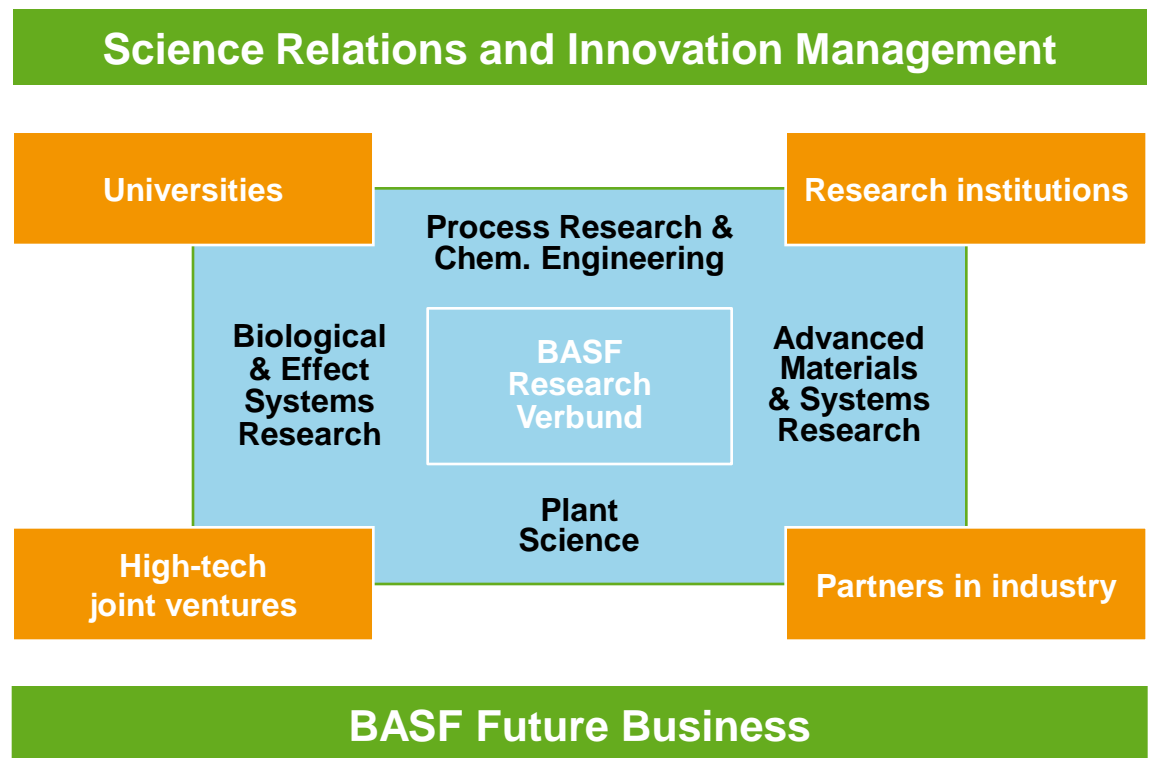


# Innovation

## Global Know-how Verbund

Thanks to our close cooperation with numerous partners from science and business worldwide, we have created an international and interdisciplinary Know-how Verbund.

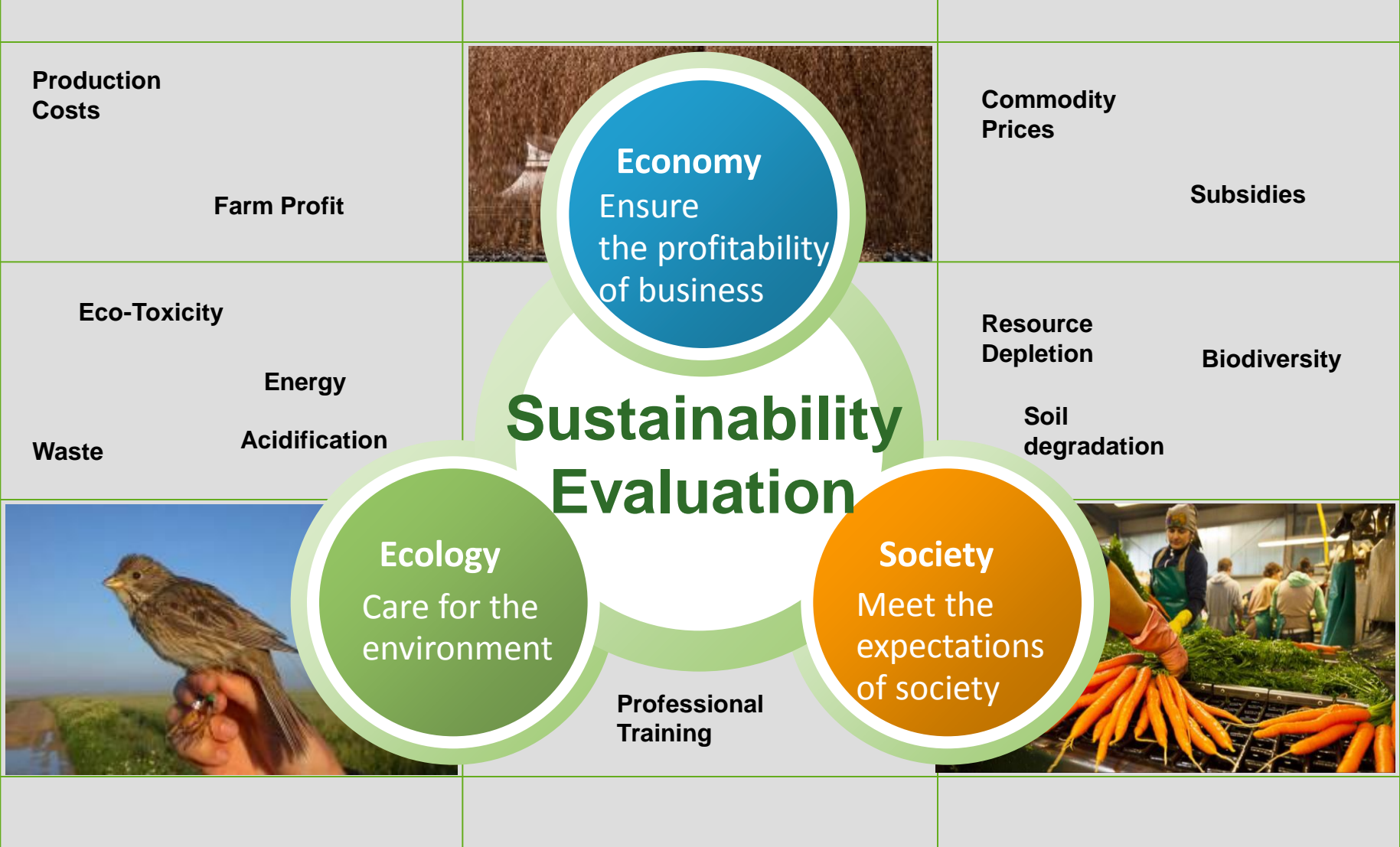
- Approx. 10,100 employees in research and development worldwide
- Research Verbund with about 1,950 cooperations



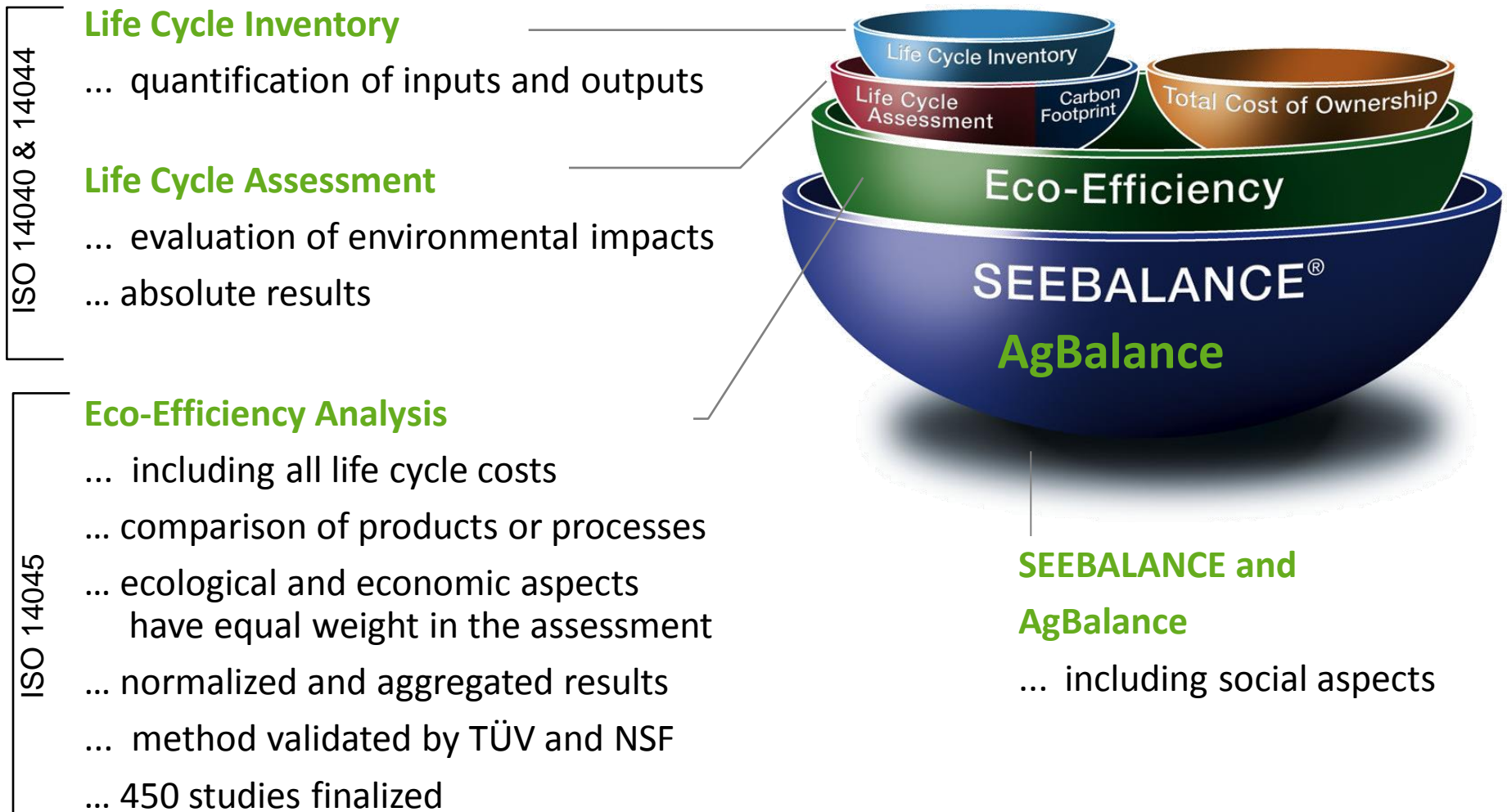


# Sustainable Development

Balancing all three dimensions

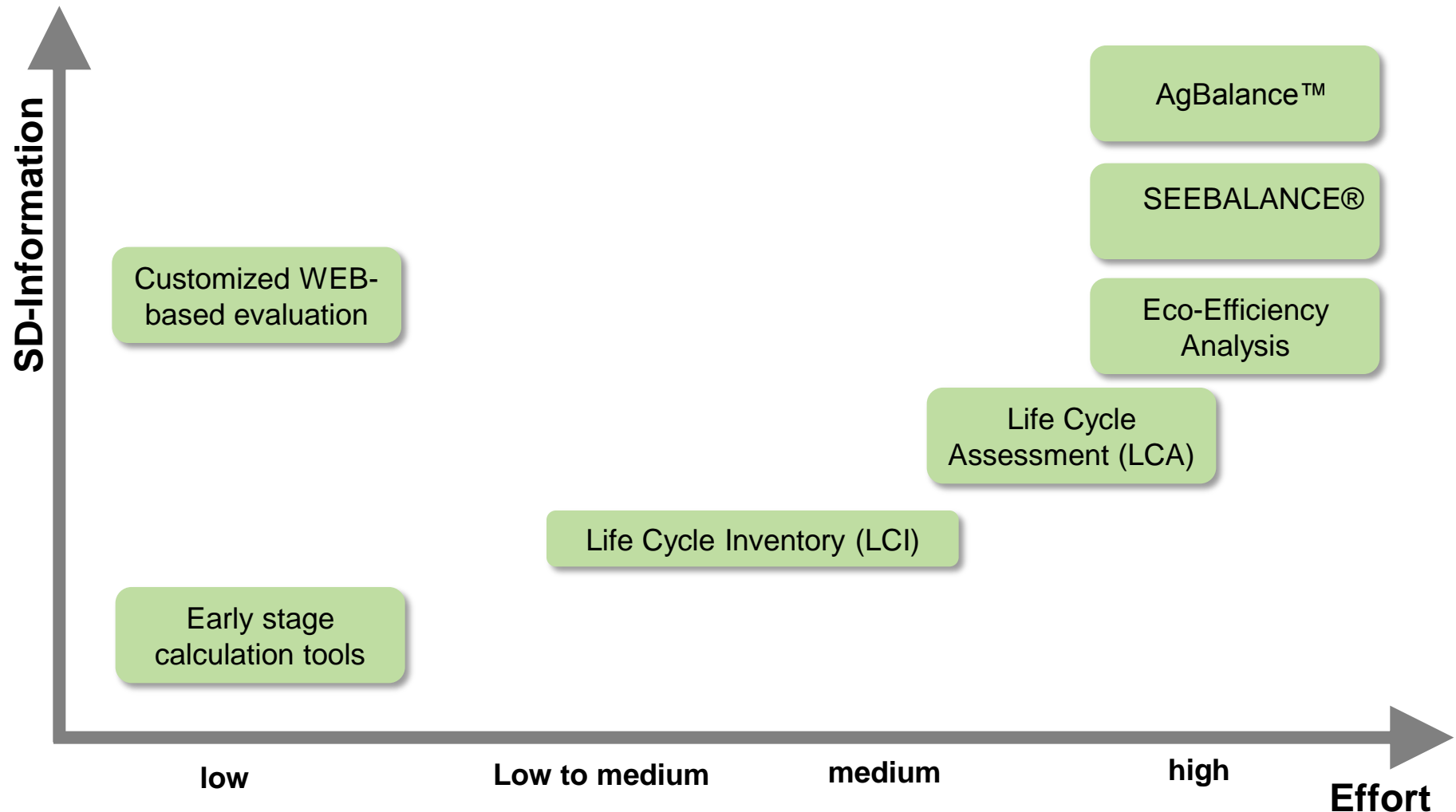


# Sustainability Assessment Methods



# Overview of information and effort requirements

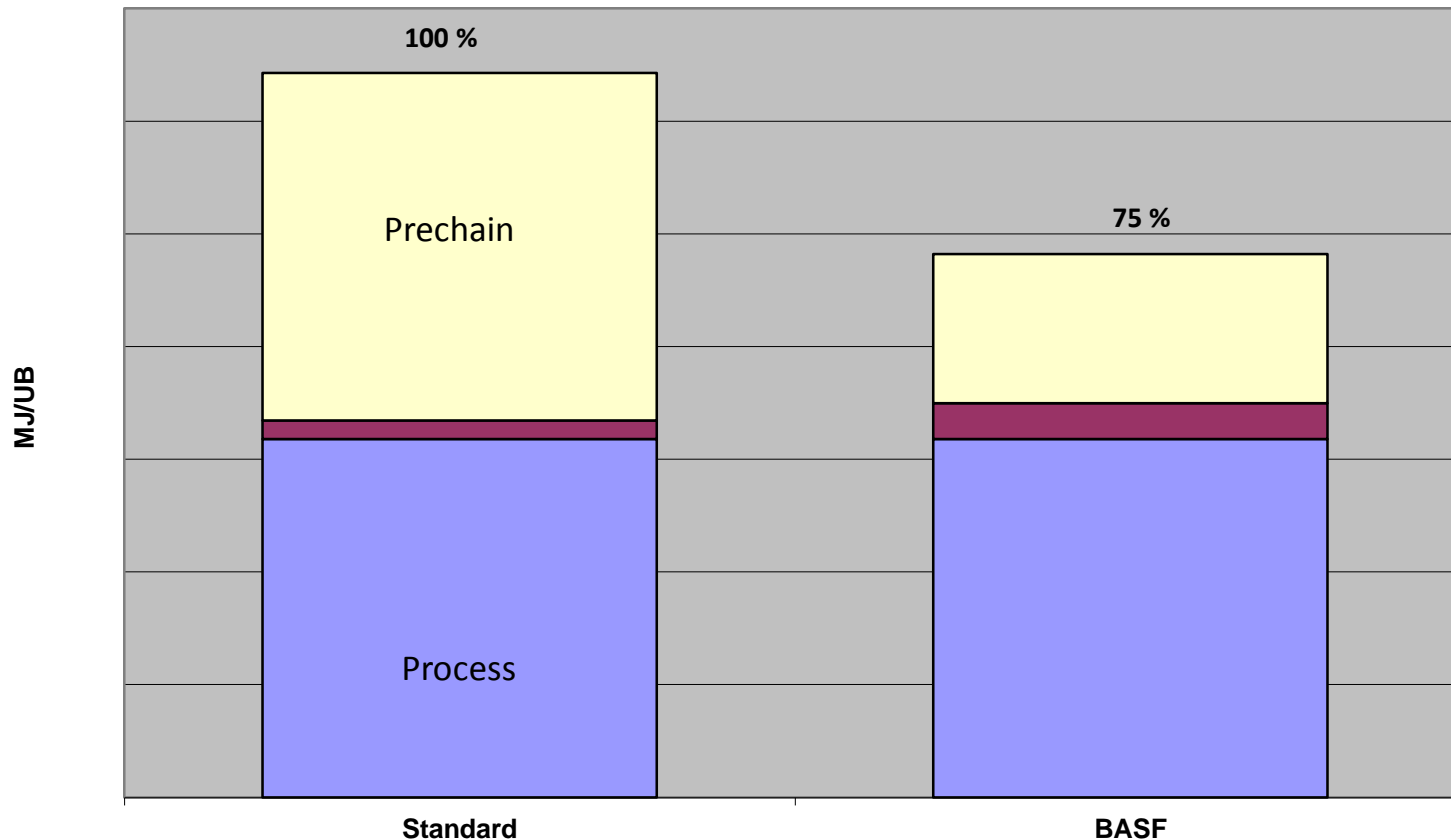
## Stepwise process enables evaluation for R&D






# Early stage evaluation of sustainability criteria with a basic set of information


## Energy Consumption as a simple example



# Summary of a Quick Evaluation method Good overview in early stages of developments

		Alternative	
		Standard	BASF
Impact Category	Resource consumption		
	CO <sub>2</sub> Emission		
	Water Emission		

 Advantage

 Disadvantage

**Considering the 3 investigated Impact Categories with the available data sources – the new product development goes in the right direction**

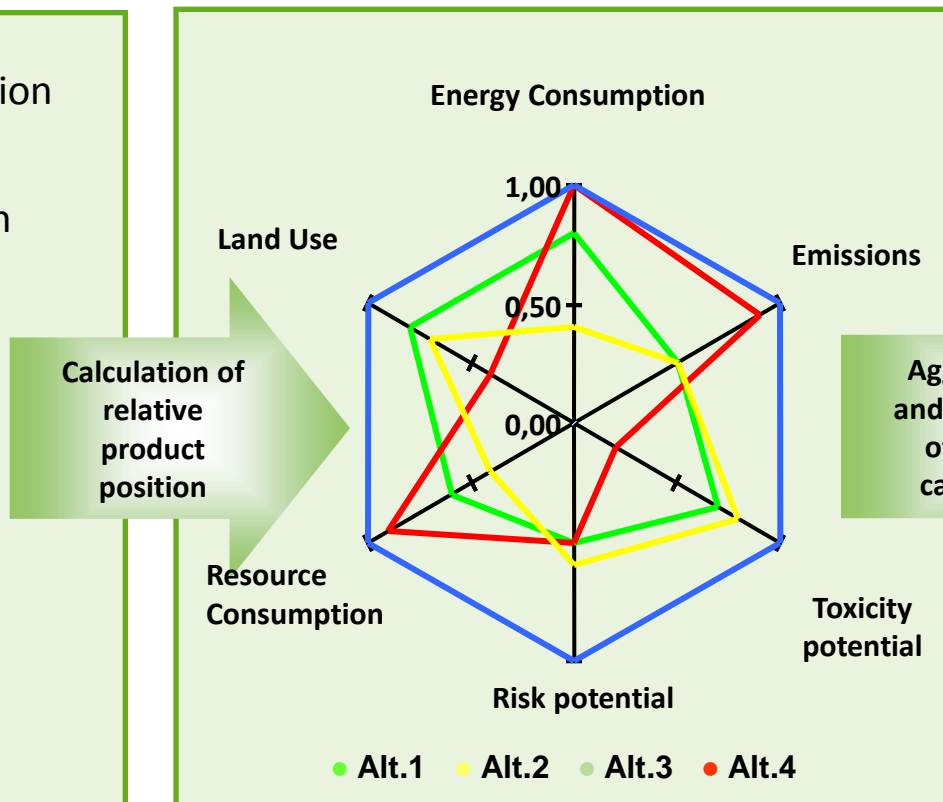
# Environmental Assessment

An essential part of our Eco-Efficiency Analysis

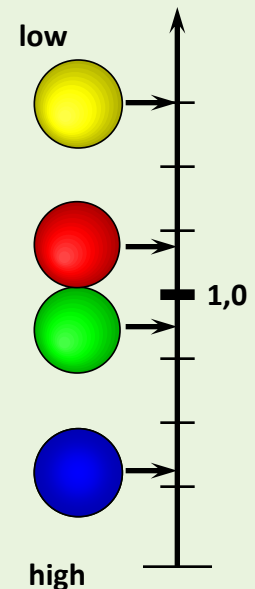
## Effect Category

Resource Consumption  
Energy Consumption  
Emissions  
Toxicity Potential  
Risk Potential  
Land Use

## Ecological Fingerprint



## Environmental Burden



→ Calculation

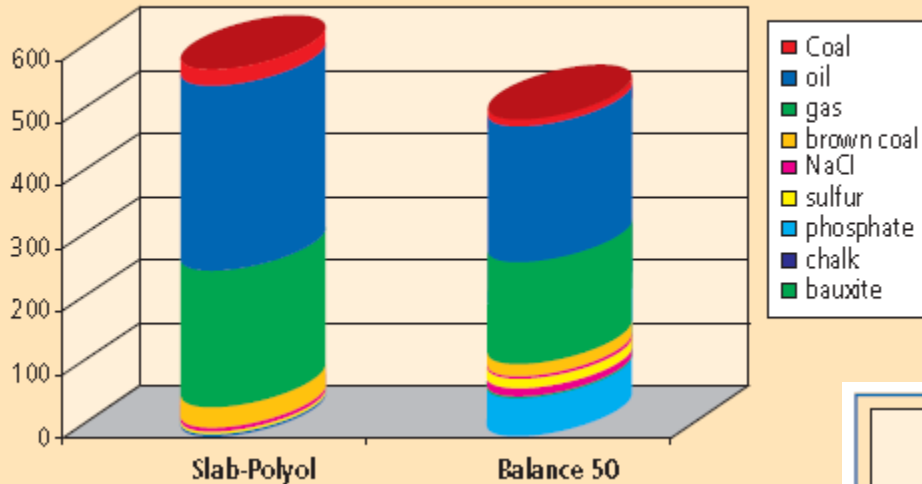
Normalization

Weighting  
and aggregation

# Evaluation based on the Ecological fingerprint

## Using castor oil to get Polyols

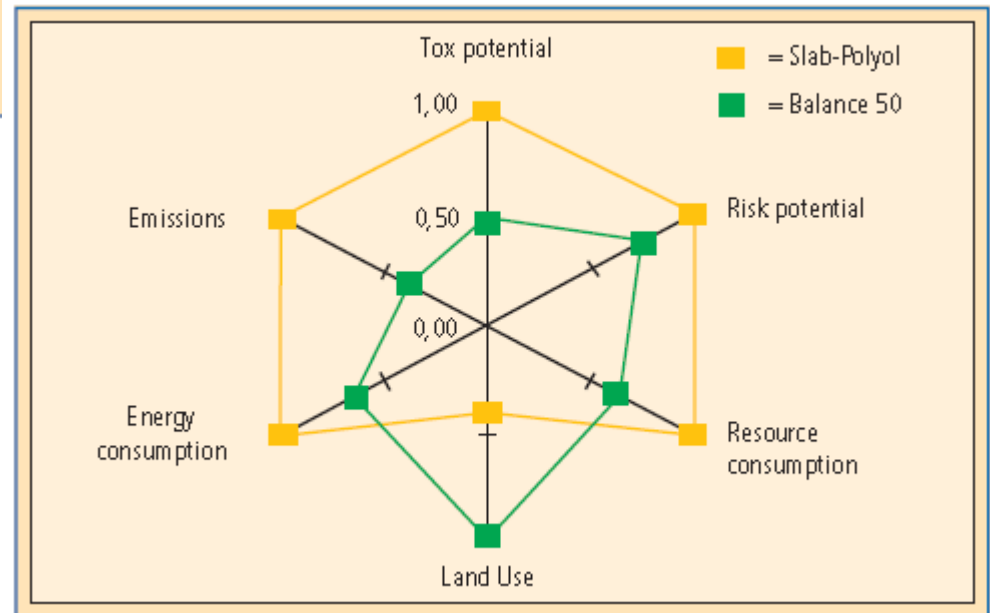
kg(a\*Mio t) 1/2 / t



**Reduced resource  
Consumption**

**Evaluation of resource factors within  
Eco-Efficiency Analysis**

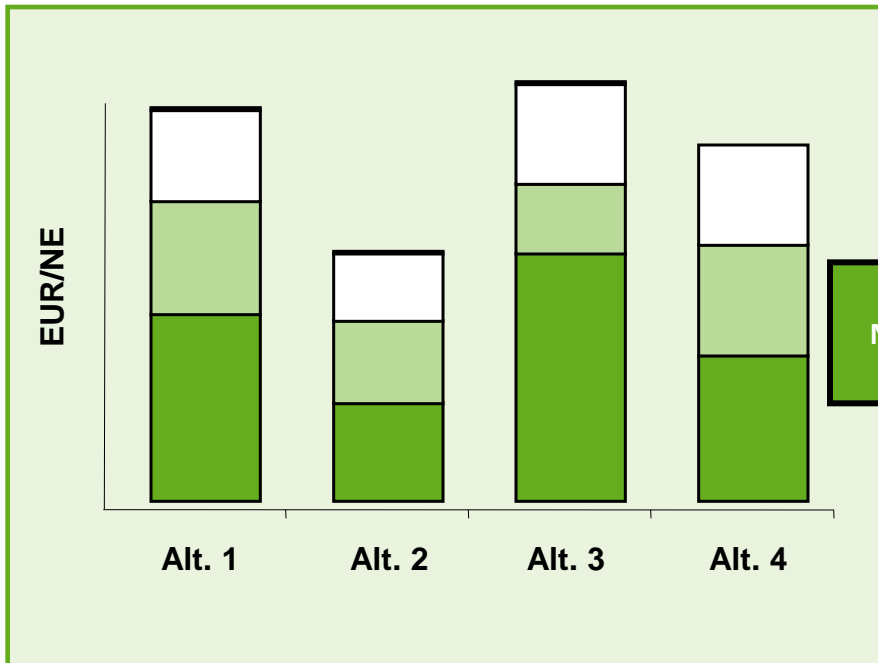
**Good  
environmental  
fingerprint**



# Cost Analysis

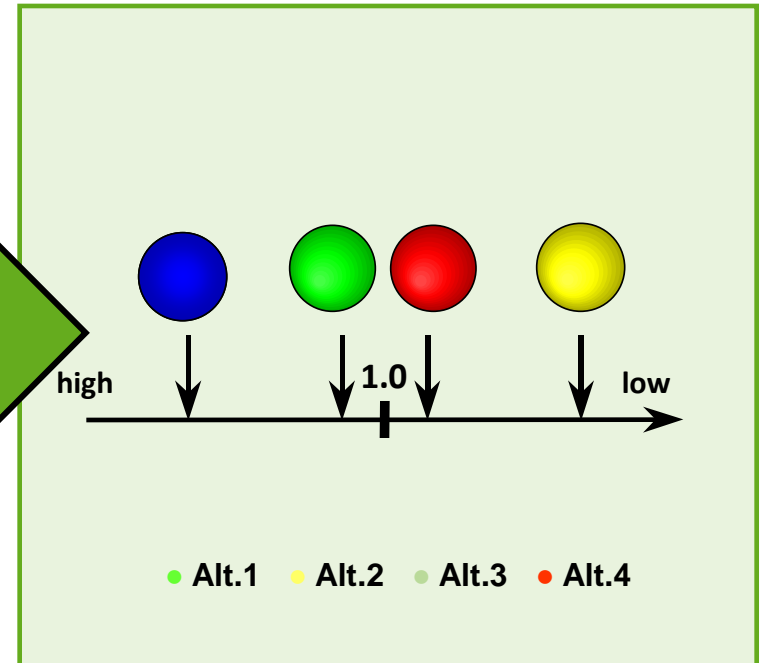
Life Cycle Costing (LCC) and Total Cost of Ownership (TCO) deliver sufficient data

Costs (absolute)



Normalization

Costs (relative)



# EEA of Amino-Carboxylate Chelating Agents vs. Phosphates

## New compounds for Dish washing

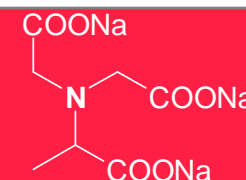
### Customer Benefit

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

### Alternatives

#### MGDA

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

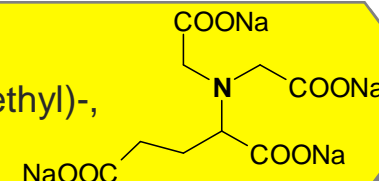


#### STPP

Sodium tripolyphosphate

#### GLDA

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

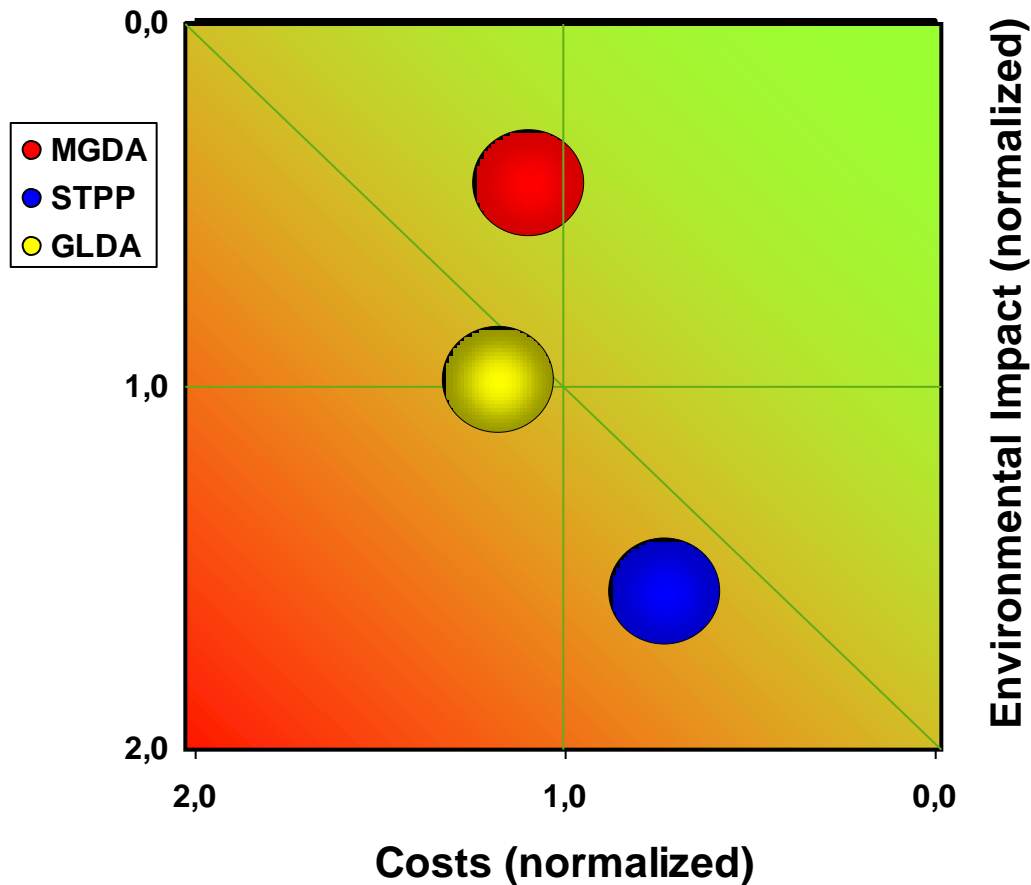


(\*) Weight of tablets is fixed and equal for all alternatives, this is achieved by addition of biobased sodium citrate and sodium sulphate



# Results displayed in the Eco-Efficiency Portfolio

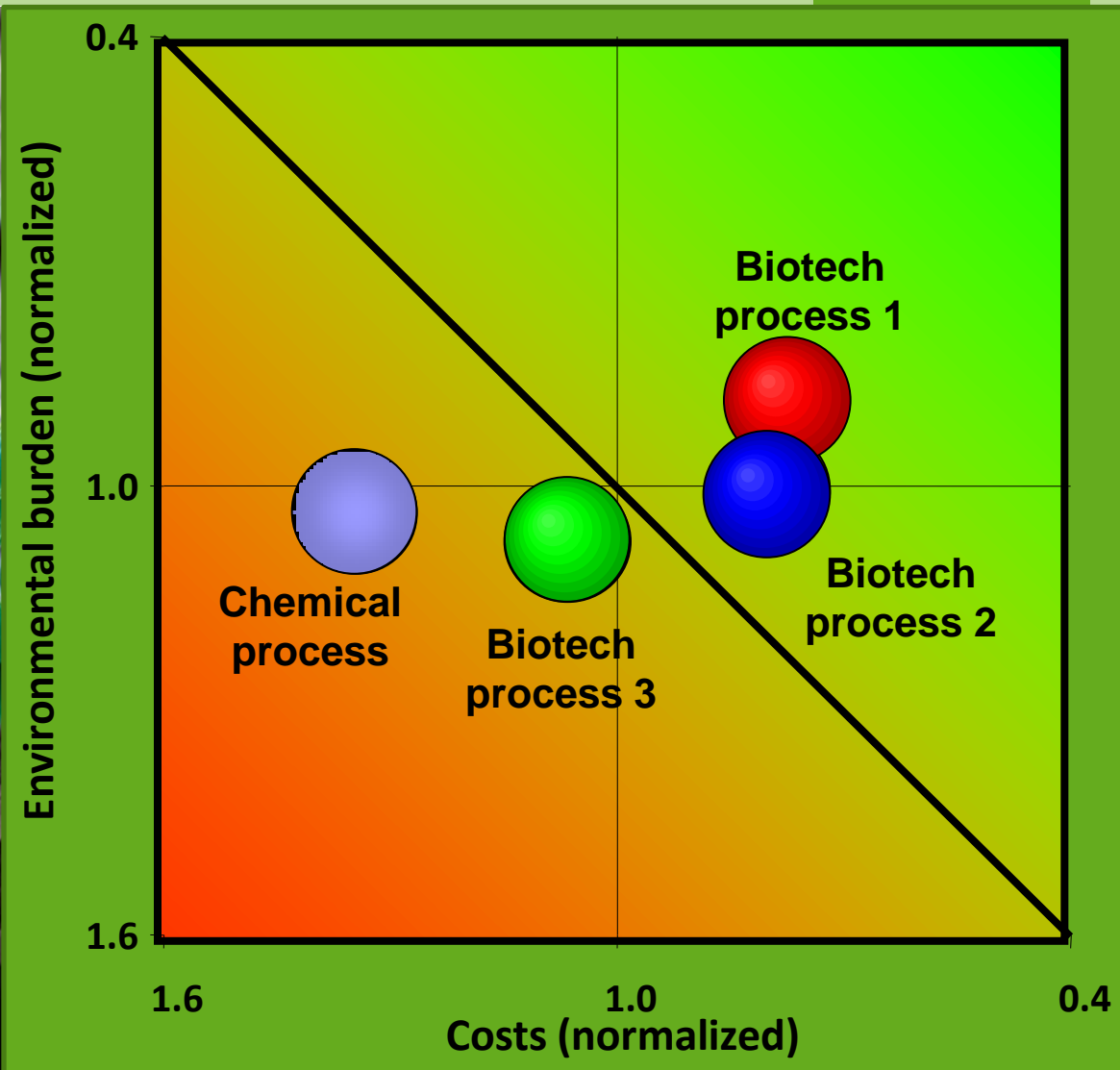
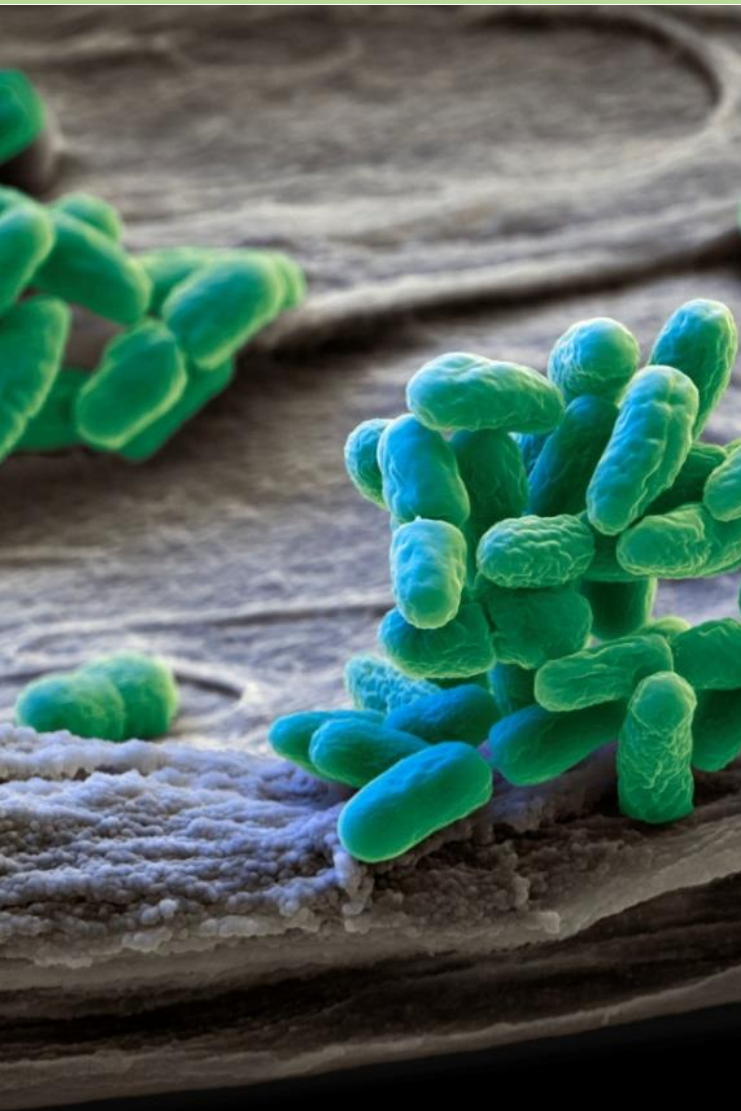
MGDA is the most sustainable alternative



- 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

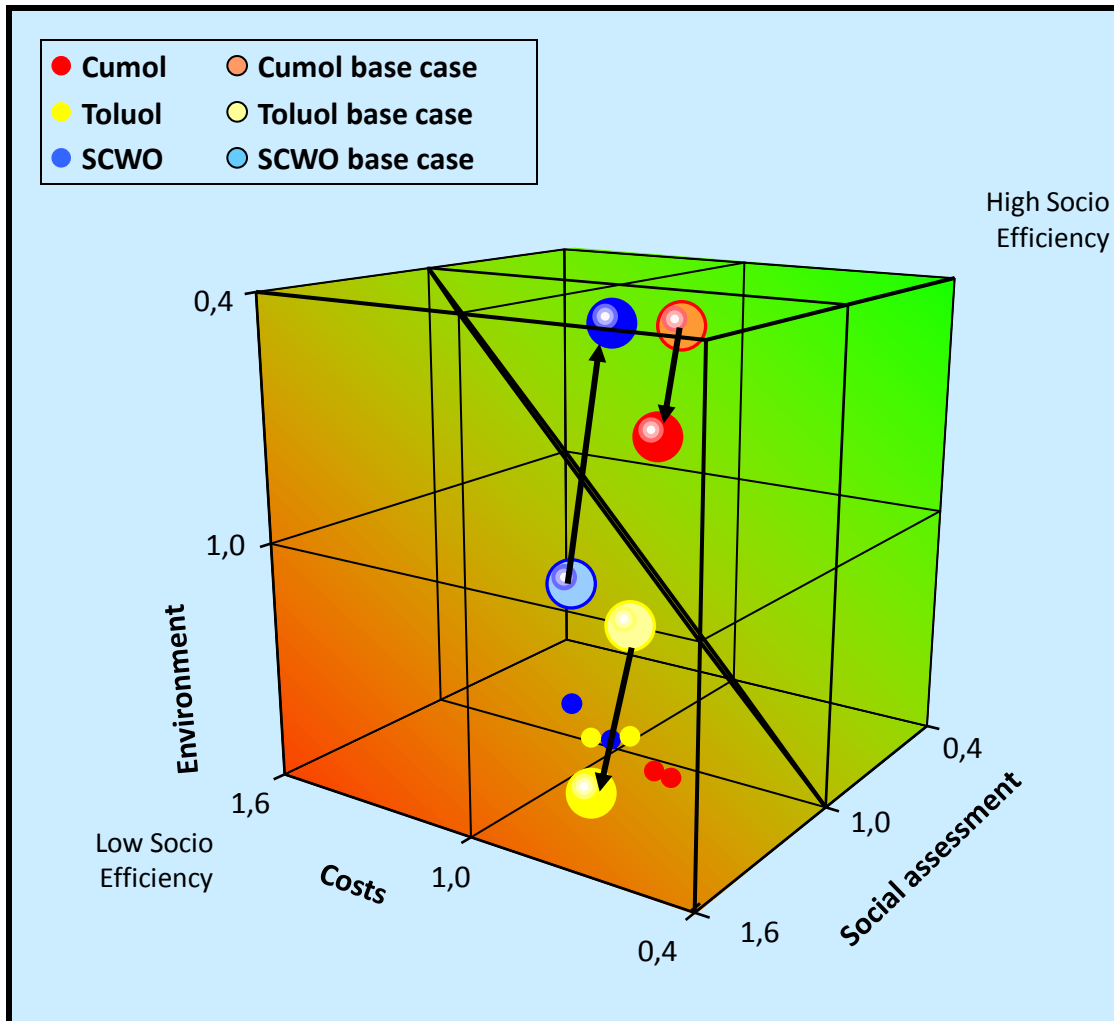
# Production of Vitamin B2

Fermentation is more sustainable than the chemical process



# SEEBALANCE of Phenol production evaluated in a BMBF Project

## R&D planning is supported



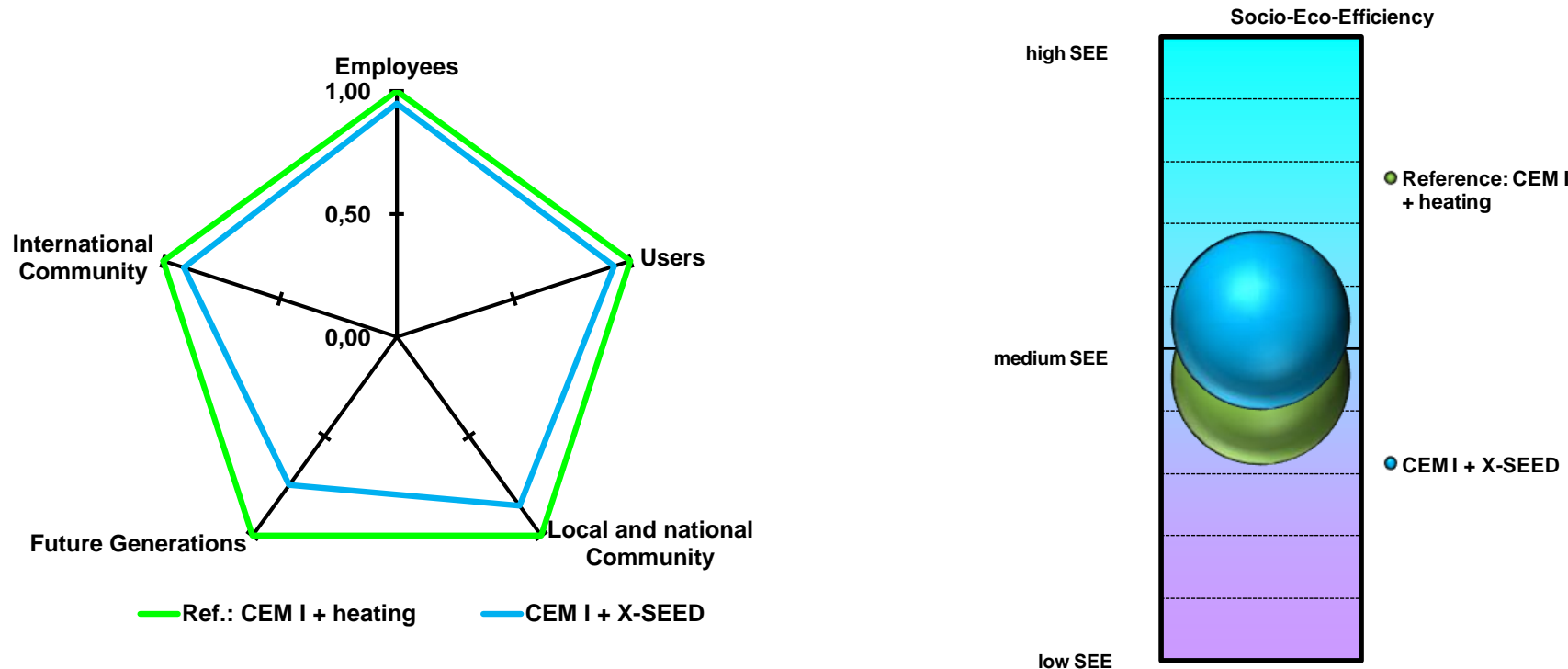
Turnover: 5 %  
 Selectivity Phenol: 50 %  
 Selectivity CO<sub>2</sub>: 30 %  
 Selectivity CO: 7,5 %  
 Selectivity Diphenylether: 12,5 %  
 Verhältnis O<sub>2</sub>: Benzene: 1: 2

Turnover: 10 %  
 Selectivity Phenol: 80 %  
 Selectivity CO<sub>2</sub>: 12 %  
 Selectivity CO: 3 %  
 Selectivity Diphenylether: 5 %  
 Ratio O<sub>2</sub>: Benzene: 1:20

**The SCWO – process could be the most eco-efficient alternative after further development**

# SEEBALANCE for cement additives X-SEED

## Nano-particulates are more sustainable



- The X-SEED mix design has economical, ecological and social advantages
- Further information: <http://www.basf.com/group/corporate/de/news-and-media-relations/science-around-us/concrete-components/info-box>

# AgBalance Method Development

## Measure sustainability in agriculture

### AgBalance

- Holistic method for life cycle assessment in agricultural and food value chain production processes
- Helps to make informed decisions on how to manage improvement
- 16 categories, 69 indicators, more than 200 evaluation factors
- Validated by:

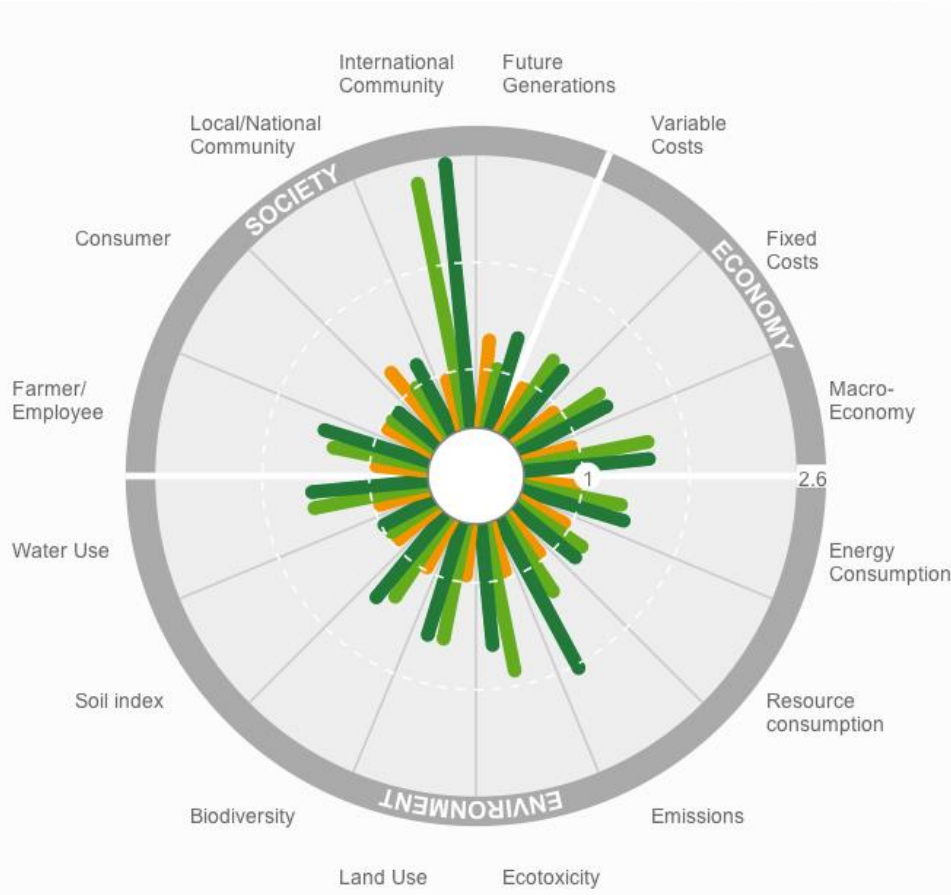
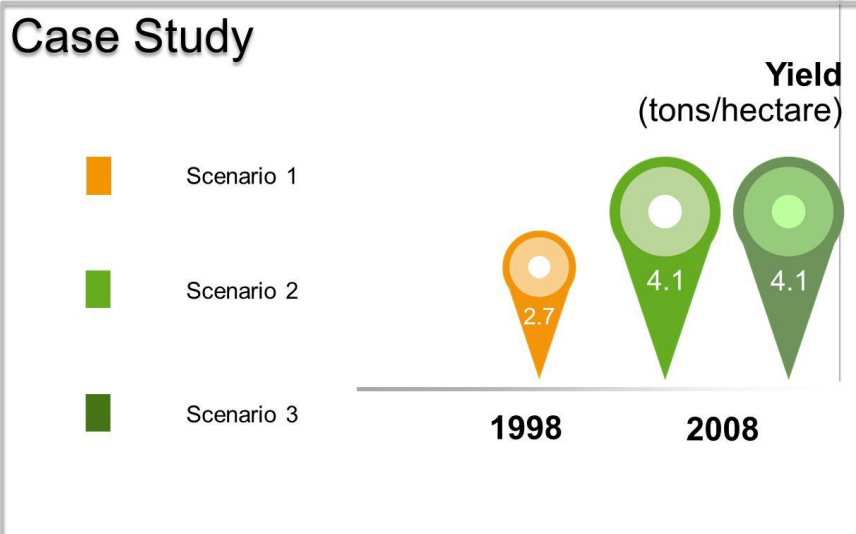


### AgBalance



# AgBalance Method Development

Measure sustainability in agriculture





# How to use the sustainability evaluation tools?

## Strong support of R&D activities

### Strategic Decisions

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

### Research and development

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

- Find the right process for the defined product
- Find more sustainable application for defined products
- Find more sustainable source for precursors
- Find the more sustainable process alternative and support investment decisions
- Find the more sustainable site for a production



The Chemical Company