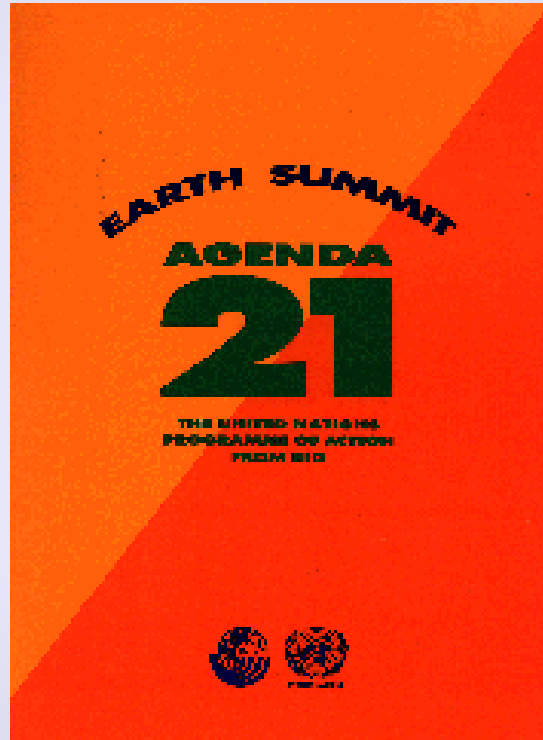


BioBeN – a software tool for the evaluation of sustainability aspects in biotechnology

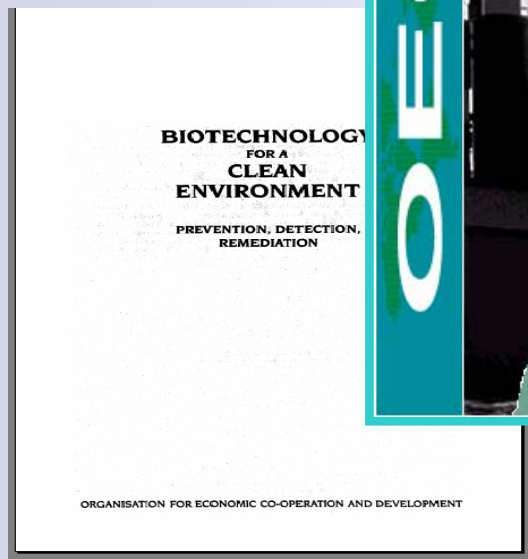
Dieter Sell
DECHEMA e.V.

Biotechnology and Sustainability



1992

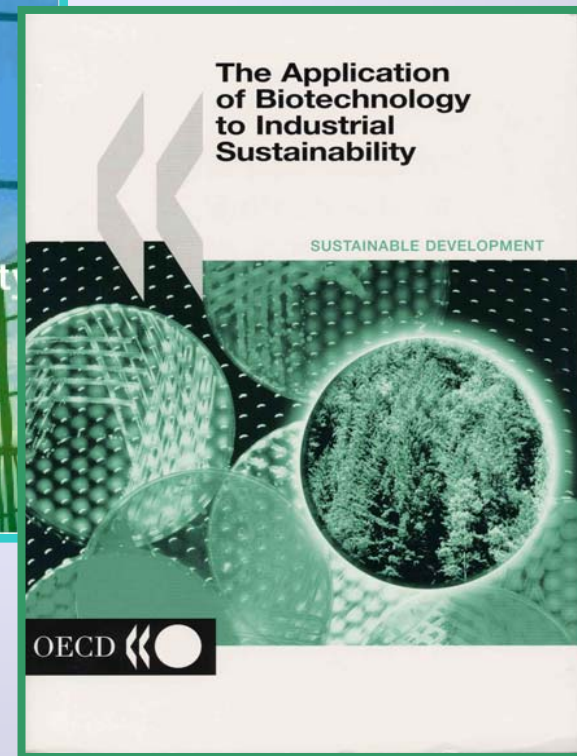
Biotechnology and Sustainability



1994

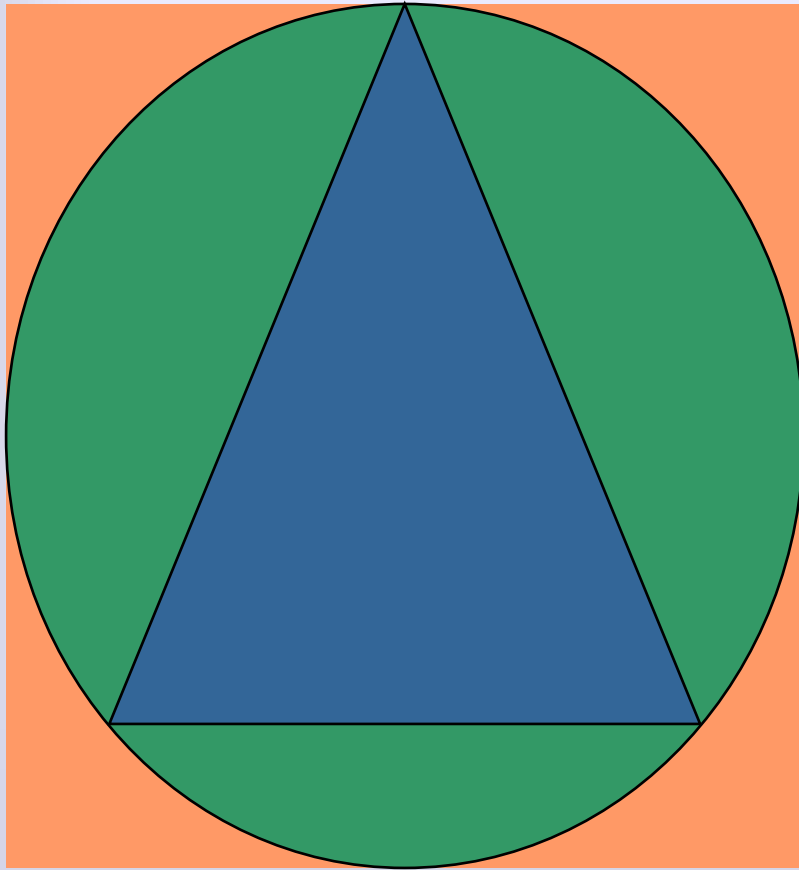


1998



2001

The three dimensions of sustainability



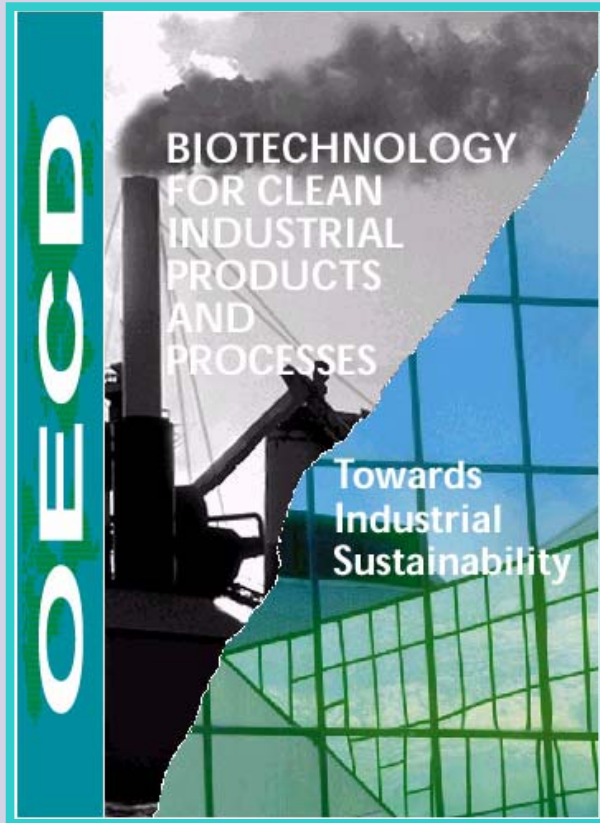
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Economy

Ecology

Society needs

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1998

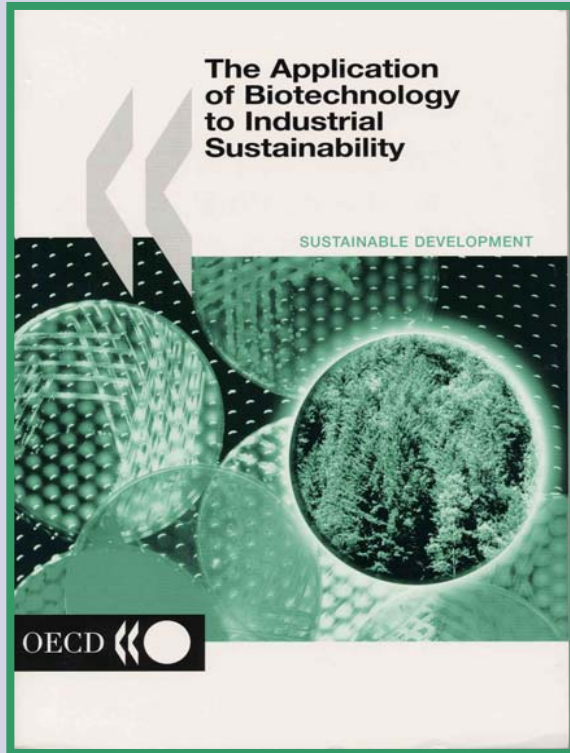
Chapter 4: Evaluating the cleanliness of biotechnological products and processes

How ?

Life-cycle assessment (LCA)

Project: Environmental Biotechnology Network

Tools: Pencil, notepad, pocket calculator, Excel



2001

Example:
Enzymatic removal of bleach residues
(Economic and ecological assessment)

but:

Tools still were:
Pencil, notepad, pocket calculator, Excel

Assessment procedure was rather
complicated and time-consuming

Biotechnological process alternatives
often were not „ready to use“ – a complete set of process data not available

Why SMEs and academia rarely use an ecoefficiency analysis



??

How can SMEs and academia take advantage of ecoefficiency analysis?

1. Cooperations

- Hire experts / consultants to perform an assessment

Drawbacks: Internal process data have to be given away

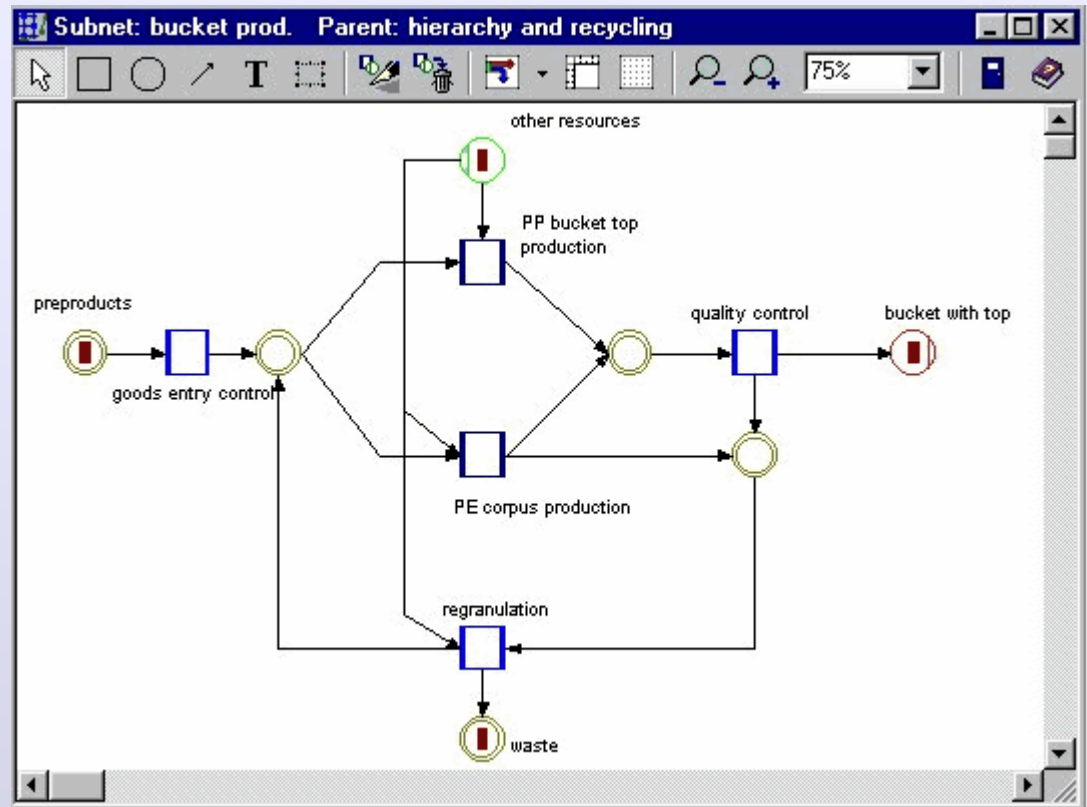
2. Software-tools

Advantages:

- fast (?)
- easy (?)
- can be used in-house

Umberto – a software-tool for material flow analysis

Modeling,
calculation and
visualization of
material and energy
flow systems:

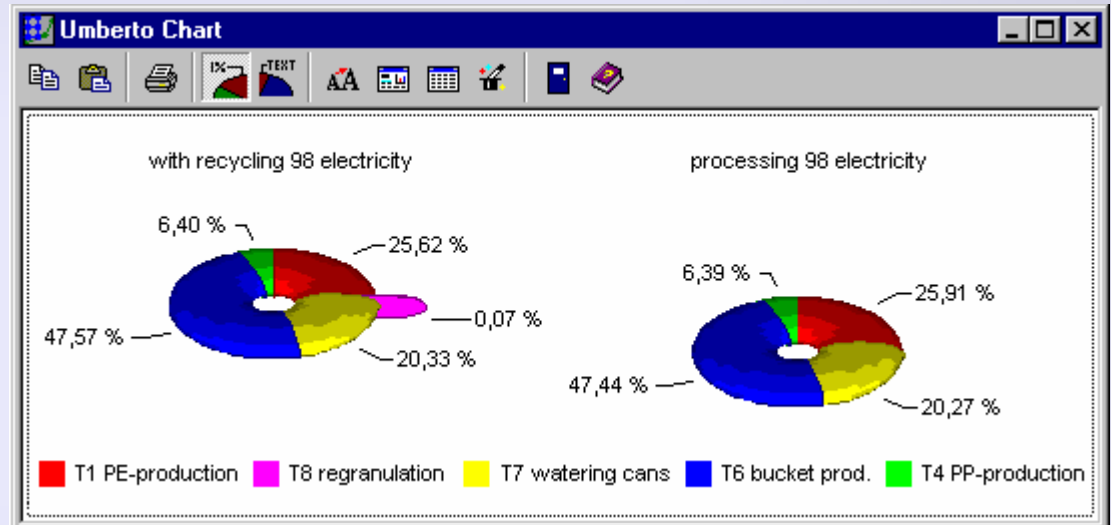


Umberto – a software-tool for material flow analysis

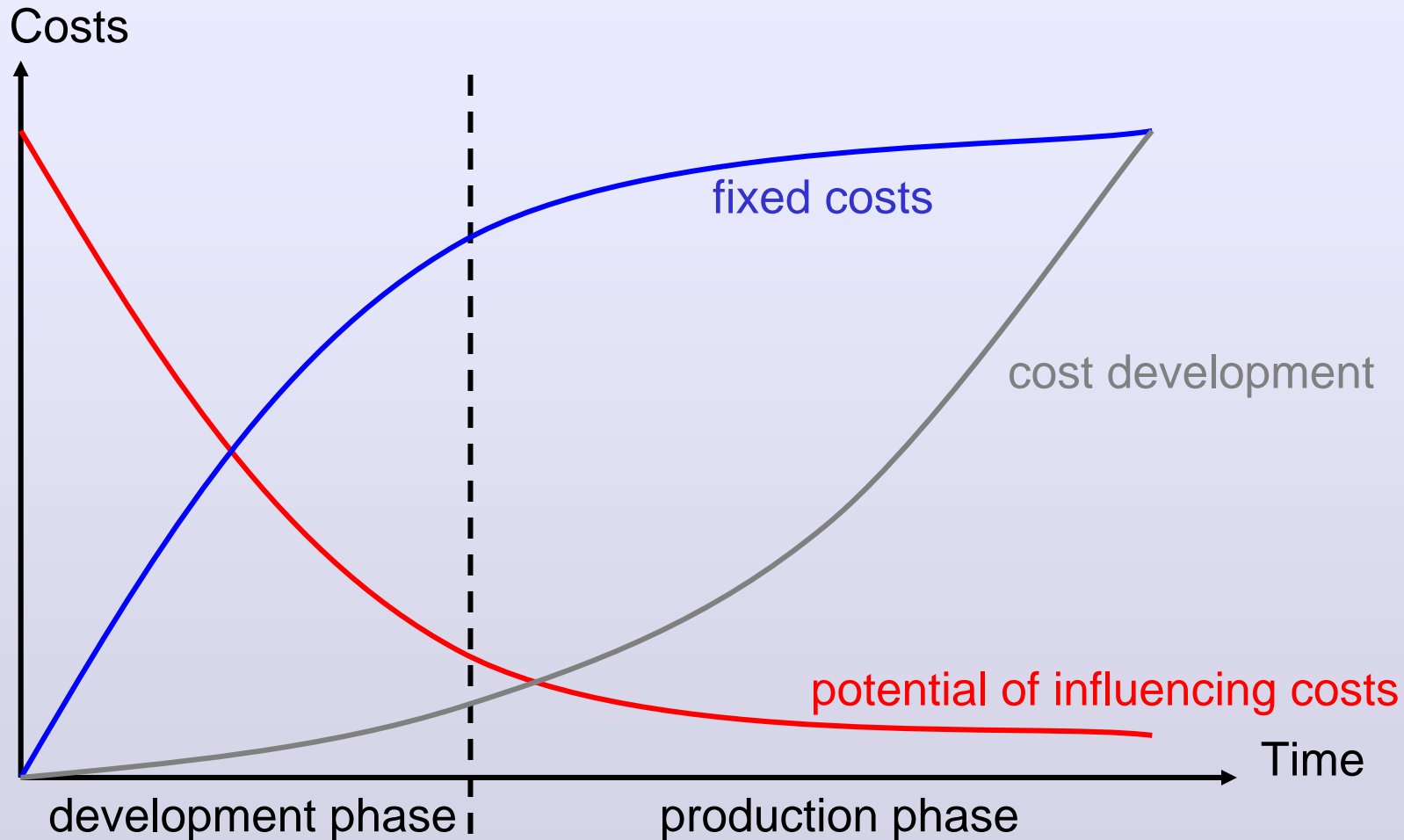
Evaluation with any set of performance indicators:

but:

Complete process-data must be available !



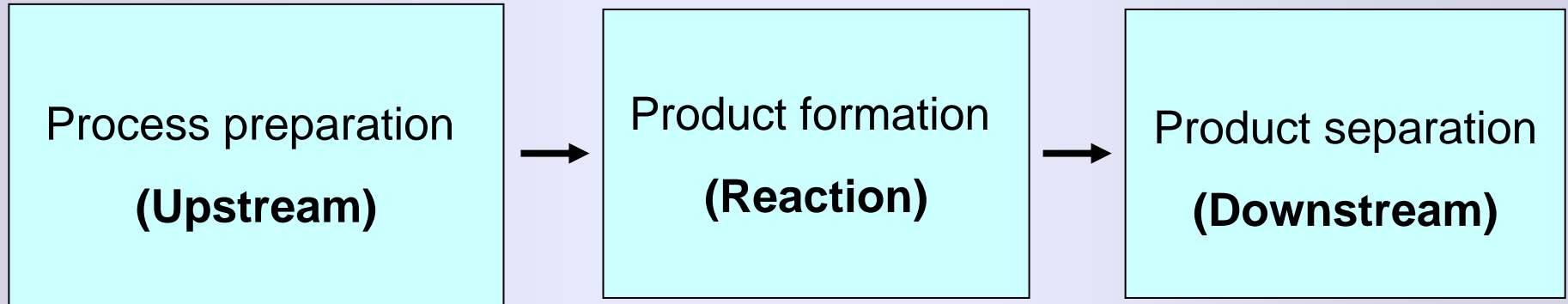
The significance of early phases



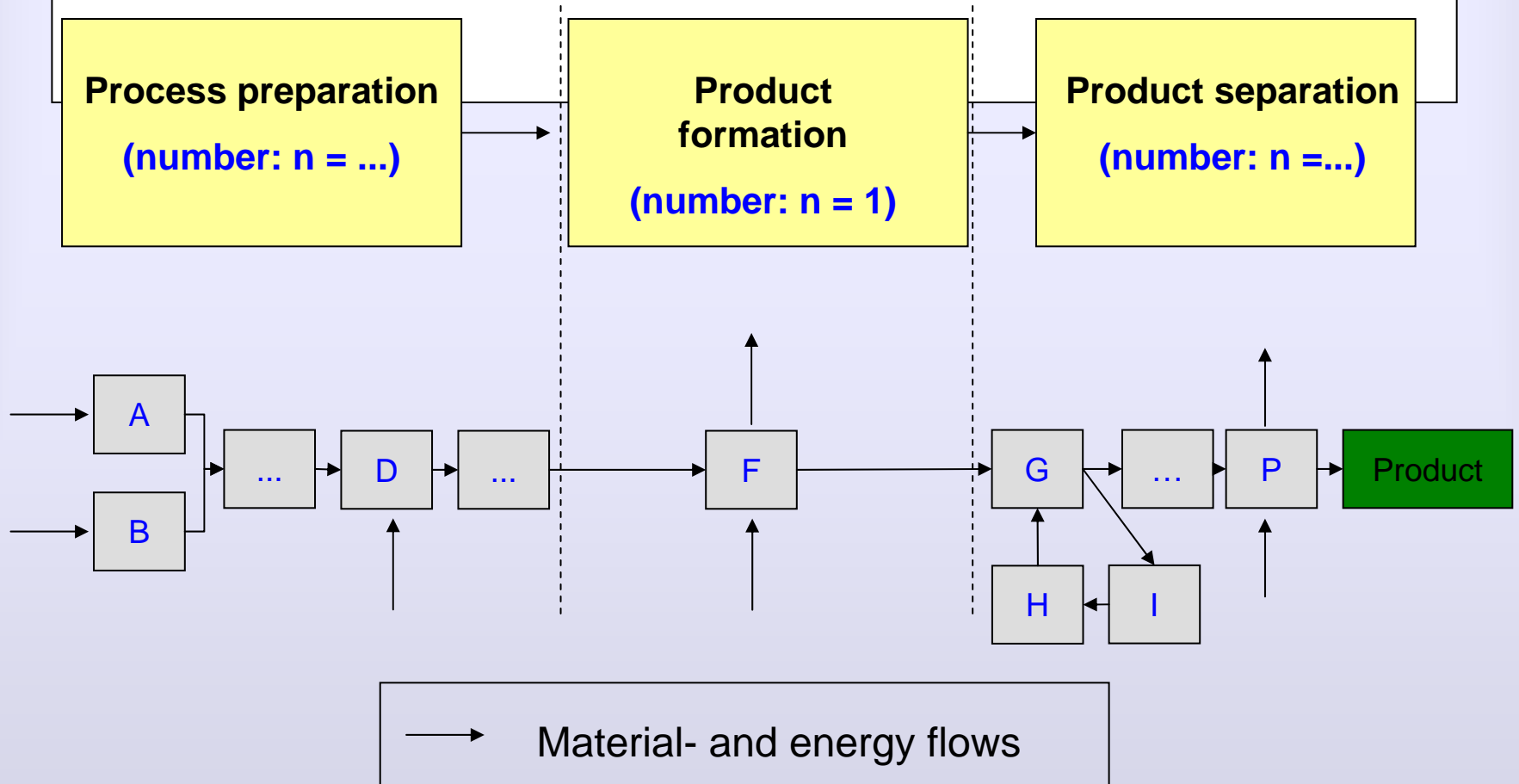
The idea of BioBeN

- Permits an **early** assessment of new biotechnological processes (allows process optimisation during process development)
- Especially suited for an application by **everybody**
- Simplifies the complexity of Umberto
 - by an user-friendly system of assistants
 - easy access to modeling and
 - analysing functions / evaluation

BioBeN: Creating a model with the basic elements of a bioprocess

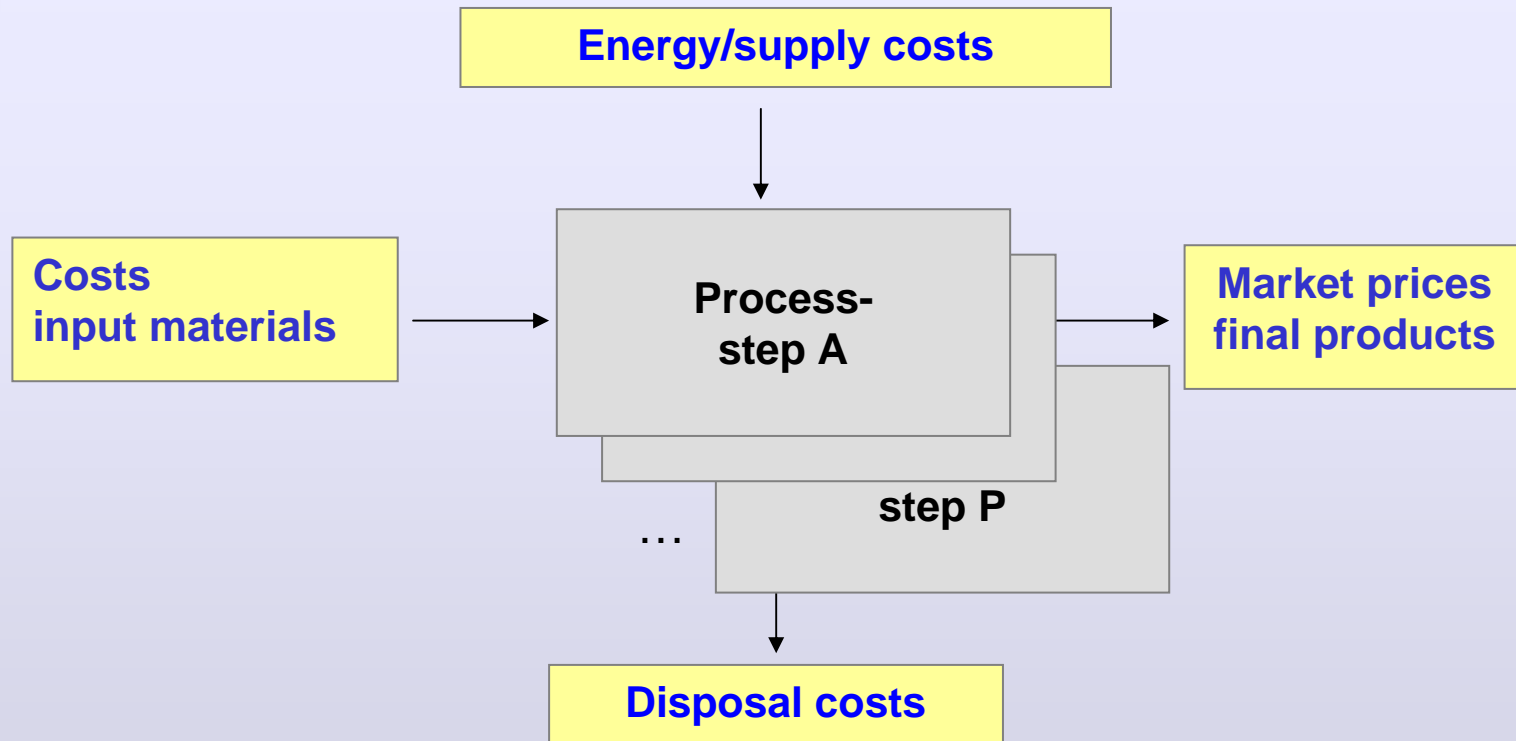


Material flows as the basis for assessments

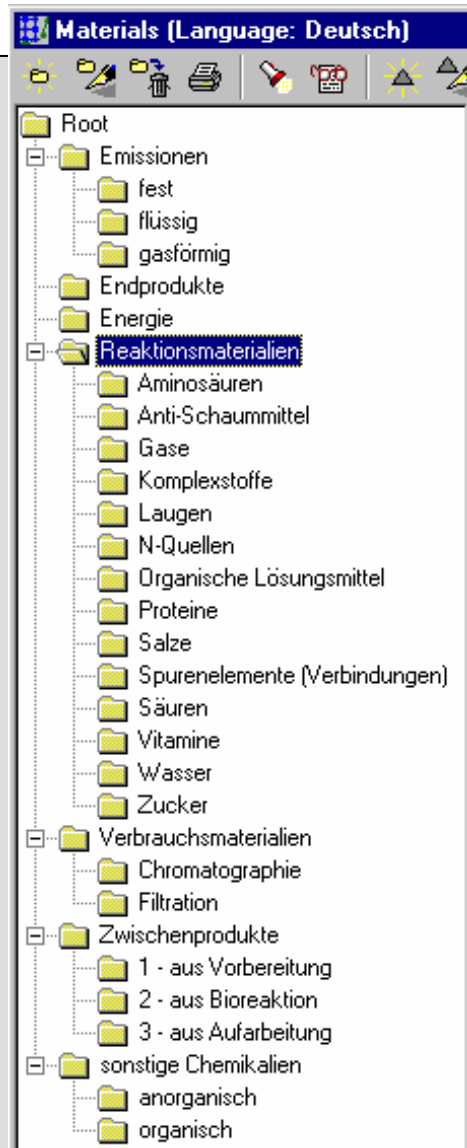


Material flows as the basis for assessments

For the different reaction steps material and energy flows with costs and ecological properties are embedded



Material-tree for BioBeN




- Typical **materials** for biotechnology are in this database
- and are **stored** with economic and ecological properties
- Simple **allocation** of new materials by the user
- Avoids duplication of entries
- **Harmonized** with the cost tree (economic evaluation)

Assistant navigation

The screenshot displays the BioBeN software interface. The main window has a menu bar with options: File, Edit, View, Draw, Attributes, Calculation, Balance, Valuation, Tools, Options, Assistants, and Windows. Below the menu bar, there are dropdown menus for Project (BioBeN), Scenario (Siderophor), and Period (01.01.2005 - 31.12.2005). The main workspace is titled "Materials (Project: BioBeN, Language: English)" and contains a tree view on the left with folders: Root, Energy, Reagents, Semi-finished goods, Waste and Emissions, Emissions, Waste, and Water. The "Reagents" folder is selected. A dialog box titled "Assistant Management" is open in the foreground. It features a "Welcome" message and the question "Which assistant to you want to start?". Below this, there is a list of assistants: Ecological Evaluation, Economic Evaluation (highlighted), and Social Evaluation. A "Language:" dropdown menu is set to "de". At the bottom of the dialog, it says "Assistant for Economic Evaluation" and has "Execute..." and "Close" buttons. The status bar at the bottom of the main window shows "Project..." and "SYSDBA at database BIOBEN\SYSDBA at library database".

Process assistant

Scaling ✕



Enter process data

Progress

- ▶ Introduction
- ▶ Define production capacity
- ▶ Purchasing a reactor
- ▶ **Enter process data**
- ▶ Preliminary result
- ▶ General survey
- ▶ Finish scaling

You want to produce the following mass per year: **10000** kg/a
Your overall purification efficiency amounts: **60** %
Due to purification losses your reactor is scaled for the production of the following mass: **16666.67** kg/a

Please enter the following specifications of your process:

What is the value of the product concentration relative to the fermentation broth resp. the reaction solution? g/L

What is the reaction time? hours

How many days of the year are available for production? (Herefrom the operating hours will be calculated.) days per year

How many fermentations/reactions will fail? (E.g. due to contaminations) %

What is the reaction temperature? °C

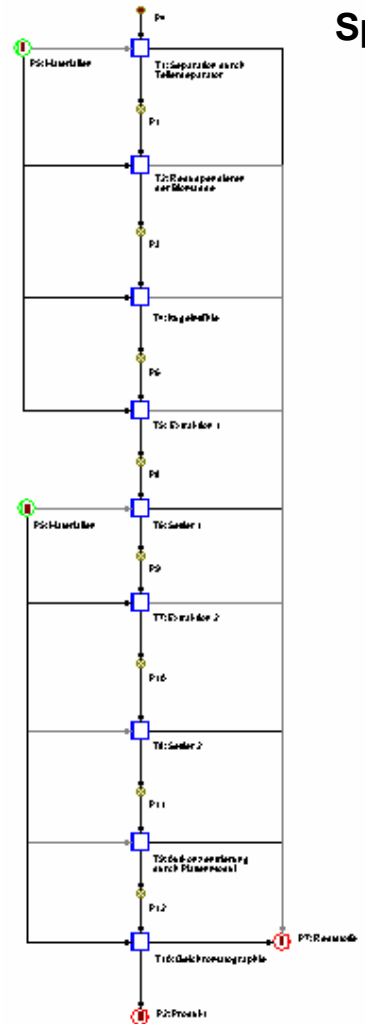
What is the reactor's degree of filling? (For microbiological processes usually 66%) -

What is the inoculation relation (Main culture to pre culture)? %



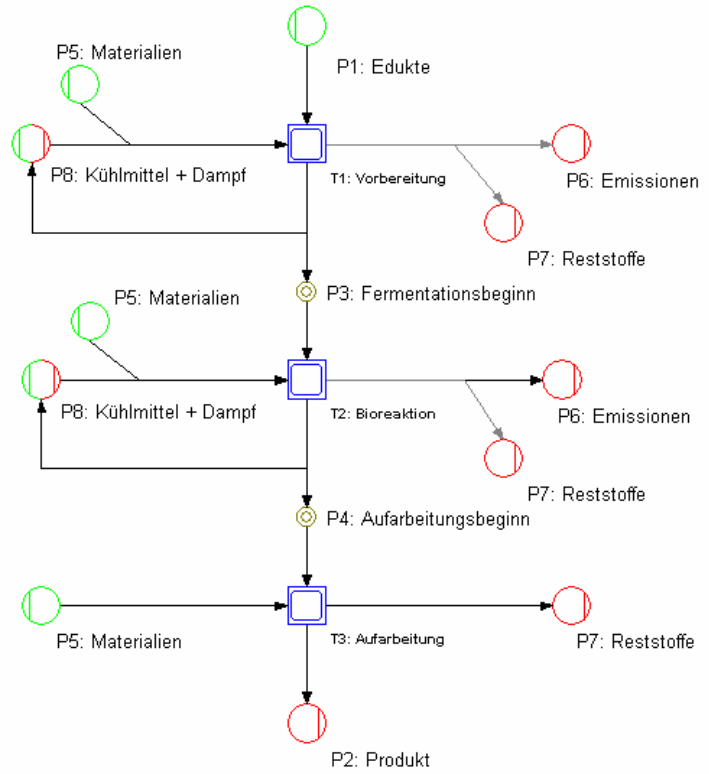
Process set-up: View of material flow network

Subnet
Downstream



Specified!

Parent-Net
Main



Specified!

Process assessment

BioBeN

File Edit View Draw Attributes Calculation Balance Valuation Tools Options Assistants Windows

Project: BioBeN Scenario: Siderophor Period: 01.01.2004 - 31.12.2004

Materials (Project: BioBeN, Language: Deutsch)

- Root
 - Emissionen und Abfälle
 - Energie
 - Reagenzien
 - Wasser
 - Zwischenprodukte

Ökologische Bewertung

Ecological evaluation

Fortschritt

- Einleitung
- Kritische Stoffe**
- Wirkungskategorien
- Umweltbewertungszahl
- Berichterstellung

Zusammenfassung der Betrachtung von A-Stoffen

Critical Substances

Bedeutung der Ampelanzeige zu den kritischen Stoffen:

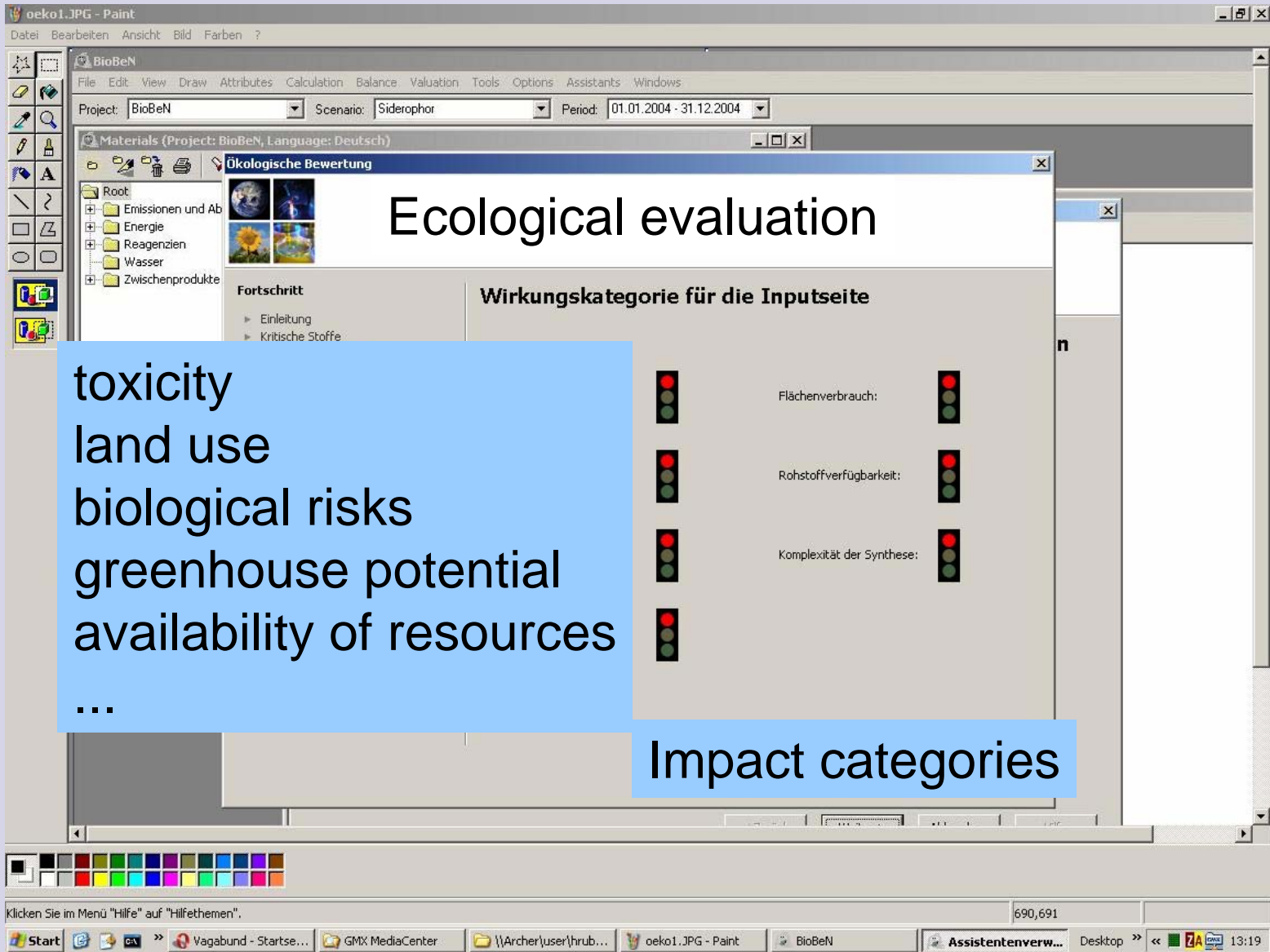
- grün: keine A-Stoffe vorhanden
- gelb: A-Stoffe vorhanden und näher betrachtet
- rot: A-Stoffe vorhanden, aber nicht näher betrachtet

< Zurück Weiter > Abbrechen Hilfe

P14:Produkt P8:Verbrennung

Project... SYSDBA at database BIOBEN_ENTWICKLUNG_CD\SYSDBA at library database BIOBEN_LIB

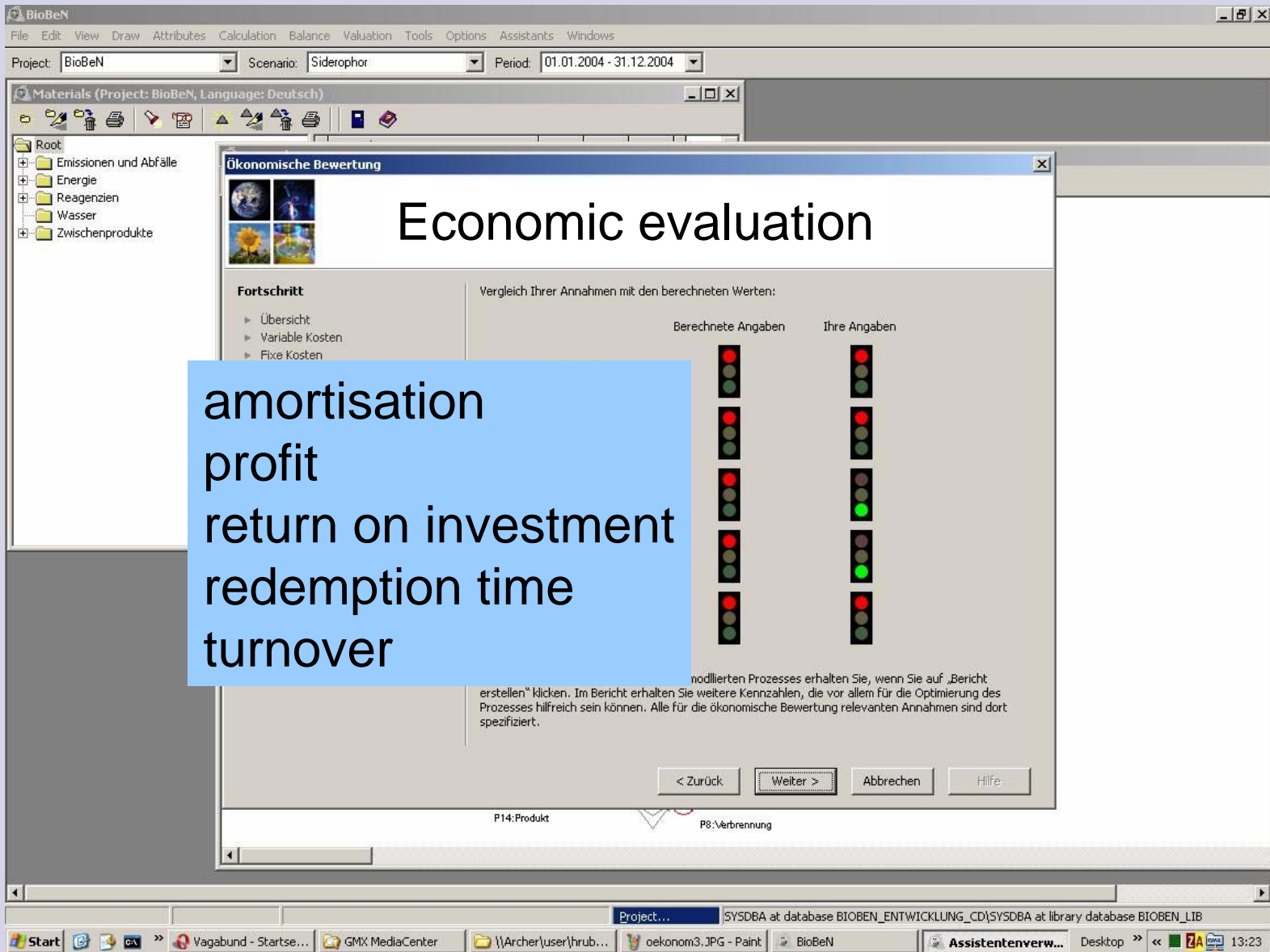
Start Vagabund - Starte... GMX MediaCenter \\Archer\user\hrub... Assistentenverwalt... BioBeN Assistentenver... Desktop 13:19



toxicity
land use
biological risks
greenhouse potential
availability of resources
...

Impact categories





amortisation
profit
return on investment
redemption time
turnover

Ökonomische Bewertung

Economic evaluation

Fortschritt

- Übersicht
- Variable Kosten
- Fixe Kosten

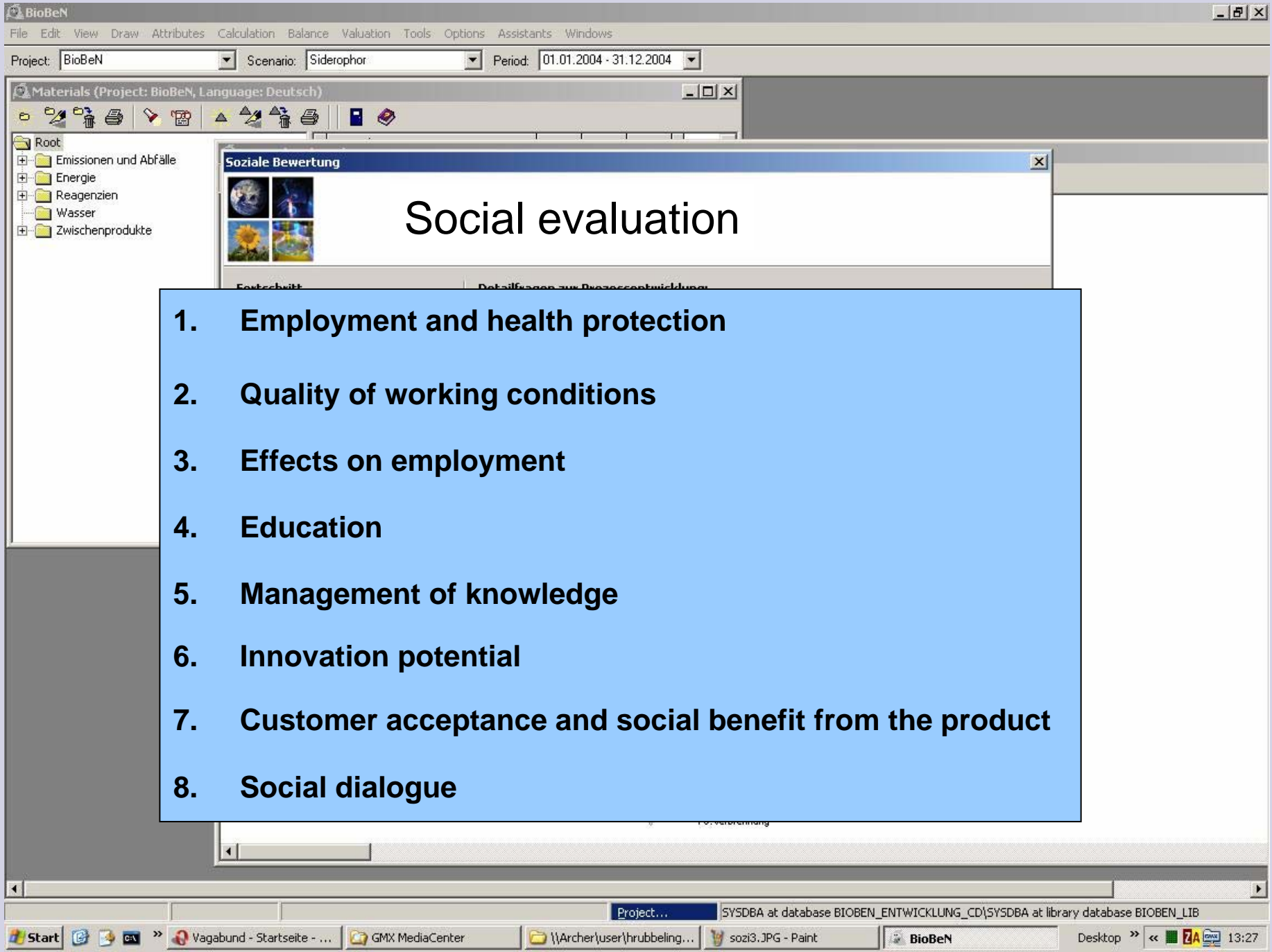
Vergleich Ihrer Annahmen mit den berechneten Werten:

	Berechnete Angaben	Ihre Angaben
1	Red	Red
2	Red	Red
3	Red	Red
4	Red	Red
5	Red	Red
6	Red	Red
7	Red	Red
8	Red	Red
9	Red	Red
10	Red	Red
11	Red	Red
12	Red	Red
13	Red	Red
14	Red	Red
15	Red	Red
16	Red	Red
17	Red	Red
18	Red	Red
19	Red	Red
20	Red	Red
21	Red	Red
22	Red	Red
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91	Red	Red
92	Red	Red
93	Red	Red
94	Red	Red
95	Red	Red
96	Red	Red
97	Red	Red
98	Red	Red
99	Red	Red
100	Red	Red

modifizierten Prozesses erhalten Sie, wenn Sie auf „Bericht erstellen“ klicken. Im Bericht erhalten Sie weitere Kennzahlen, die vor allem für die Optimierung des Prozesses hilfreich sein können. Alle für die ökonomische Bewertung relevanten Annahmen sind dort spezifiziert.

< Zurück Weiter > Abbrechen Hilfe

P14:Produkt P8:Verbrennung



- 1. Employment and health protection**
- 2. Quality of working conditions**
- 3. Effects on employment**
- 4. Education**
- 5. Management of knowledge**
- 6. Innovation potential**
- 7. Customer acceptance and social benefit from the product**
- 8. Social dialogue**

BioBeN

File Edit View Draw Attributes Calculation Balance Valuation Tools Options Assistants Windows

Project: BioBeN Scenario: Siderophor Period: 01.01.2004 - 31.12.2004

Materials (Project: BioBeN, Language: Deutsch)

- Root
 - Emissionen und Abfälle
 - Energie
 - Reagenzien
 - Wasser
 - Zwischenprodukte

Soziale Bewertung

Social evaluation

Results

Fortschritt

- Einleitung
- Fragen
 - Arbeits- u. Gesundheitsschutz
 - Qualität der Arbeitsbedingungen
- Gesellschaftlicher Dialog
- Ergebnisse

Auswertungsübersicht

Arbeits- und Gesundheitsschutz:	
Qualität der Arbeitsbedingungen:	
Beschäftigungseffekte:	
Aus- und Weiterbildung:	

< Zurück Weiter > Abbrechen Hilfe

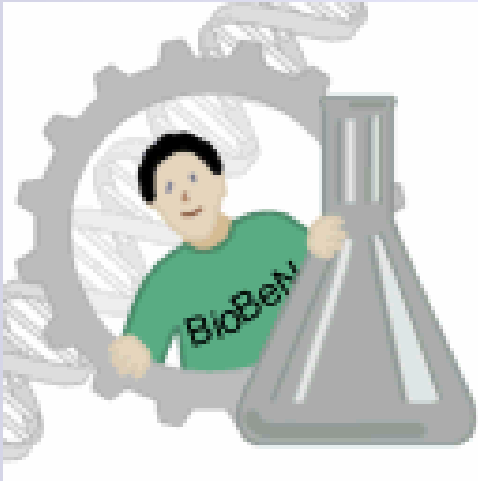
P14:Produkt P8:Verbrennung

Project... | 5Y5DBA at database BIOBEN_ENTWICKLUNG_CD\5Y5DBA at library database BIOBEN_LIB

Start | Vagabund - Startseite - ... | GMX MediaCenter | \\Archer\user\hrubbeling... | sozi4.JPG - Paint | BioBeN | Desktop >> | 13:30

Biotechnology and Sustainability

Today:



Tools are:

Pencil, notepad, pocket calculator, Excel,
Umberto and BioBeN

Assessment procedure is **less**
complicated and time-consuming

Biotechnological process alternatives,
although not „ready to use“ – can be
evaluated, even if the process data are
not yet completely known !

The BioBeN – Project team

- Dieter Sell
Peter Gebhart
Eckhard Renken



- Christa Liedtke
Holger Wallbaum
Justus von Geibler



- Klaus Bellmann
Alexander Danek



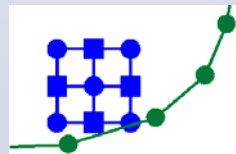
- Holger Rohn



- Elmar Heinzle
Abdul Kholiq



- Hendrik Rubbeling
Volker Wohlgemuth
Martina Prox



ifu Hamburg GmbH



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Thank you for your attention !