



Entrepreneurial decision making for investments in sustainable technologies

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September 20th, 2005**

Study commissioned by the “Fördergesellschaft
für Forschung und Ausbildung in Unternehmenswissenschaften
an der ETH Zürich” (FG FAU)

AGENDA



- **A survey among Swiss companies**

- **New design paradigms for sustainable technologies**

- **Conclusions**

The aim of this survey in the Swiss industry was to get a better understanding of the chances and risks of sustainability

OBJECTIVES

Perception & Meaning

Understand the meaning of sustainability in entrepreneurial actions in Swiss technology oriented companies

Chances & Risks

Elucidate and discuss chances and risks from an entrepreneurial viewpoint

Obstacles & Expectations

Identify implementation obstacles and expectations from society

Methodically the survey was based on an explorative questionnaire and in-depth expert interviews

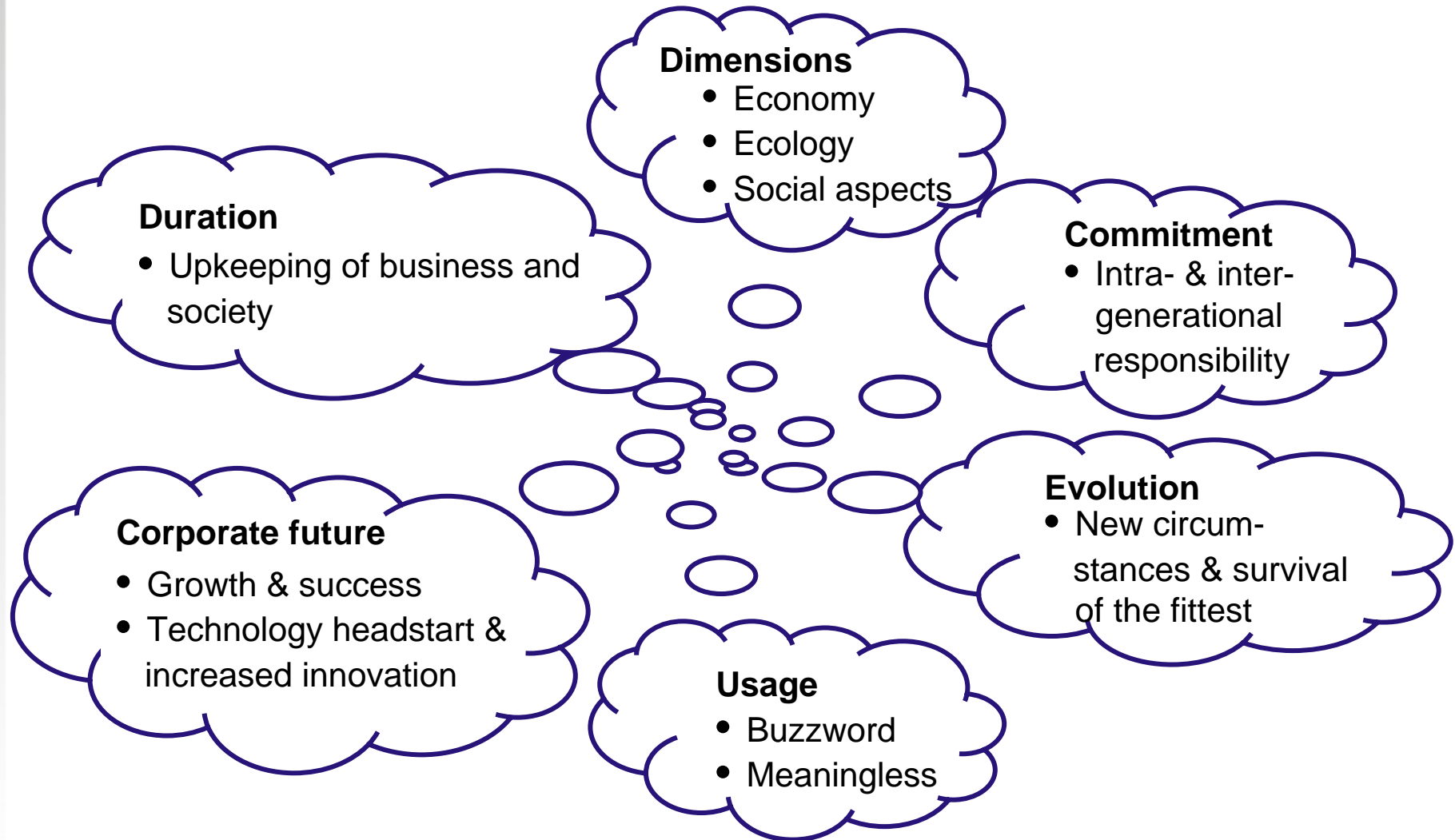
MAIN ELEMENTS

	1		2	
	Wide information analysis through a web based explorative survey		Detailed interviews with industrial experts (mostly CEO/managers)	
	Enquiries	Replies	Enquiries	Replies
FG FAU	36	12	3	3
ÖBU*	112	19	5	5
Others	294	33	6	6
Response		14,5%		100%

* Swiss association of ecologically conscious companies

The survey shows clear familiarity with the concept of sustainability, yet there is a wide spectrum of associations

SPONTANEOUS ASSOCIATIONS WITH „SUSTAINABILITY“



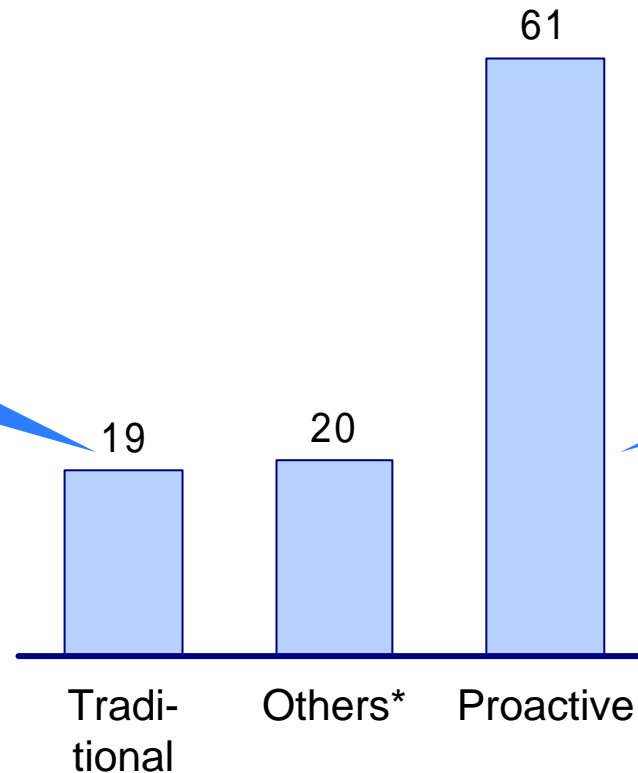
The majority of the companies surveyed claim a proactive view on sustainability

INTERPRETATION SUSTAINABILITY IN BUSINESSES

In percent

„Traditional“

- **Steady profit growth; adhere to environmental and social conditions**
- Companies that are either big or quoted on the stock exchange show a more traditional view



"Proactive"

- **Achieve adequate profits; reduce ecological damage; increase social standards**
- Especially small businesses* and family businesses show a clear proactive view

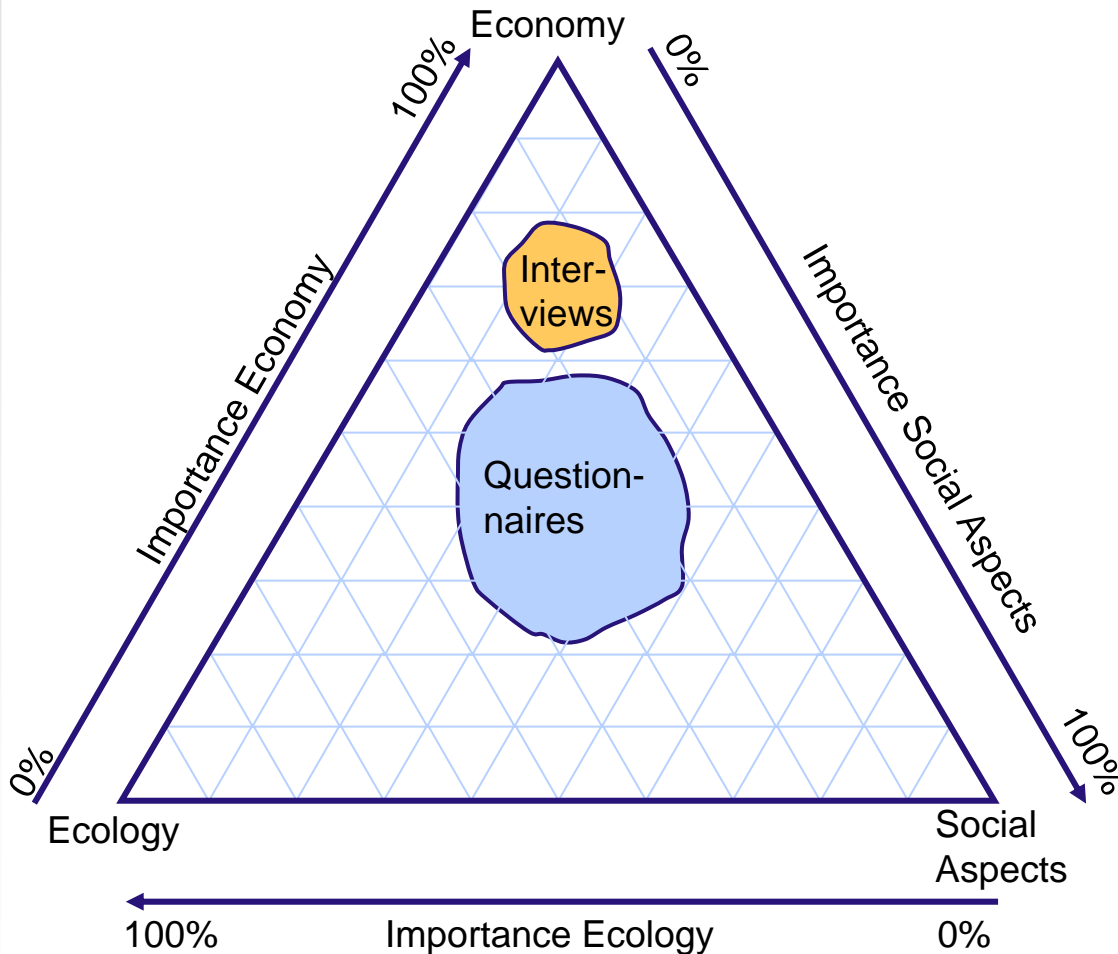
* Contains „Brundtlands“, „Culturals“, „System People“ and „Waverers“

** Less than 1000 employees

All three pillars of sustainability are regarded as important, yet the economic dimension seems to dominate decisions

IMPORTANCE OF SUSTAINABILITY DIMENSIONS

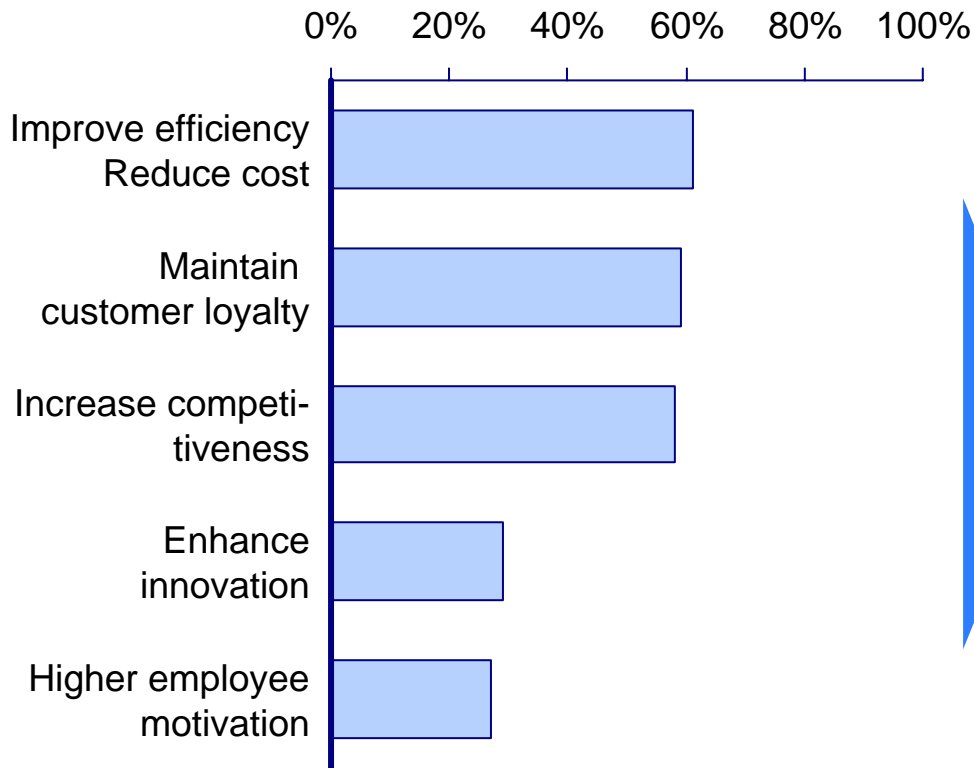
- Interviews
- Questionnaires



- **In the questionnaires**, the majority of companies indicated all three sustainability dimensions as equally important
- **In detailed interviews** with business representatives there was agreement about the outstanding importance of the economic dimension
- Ecological and social criteria are sometimes seen as criteria for „knock-out“ or in case of „tight decisions“

Fundamental reasons for sustainability engagement are cost reduction and improvement of customer loyalty

REASONS FOR SUSTAINABILITY ENGAGEMENT*

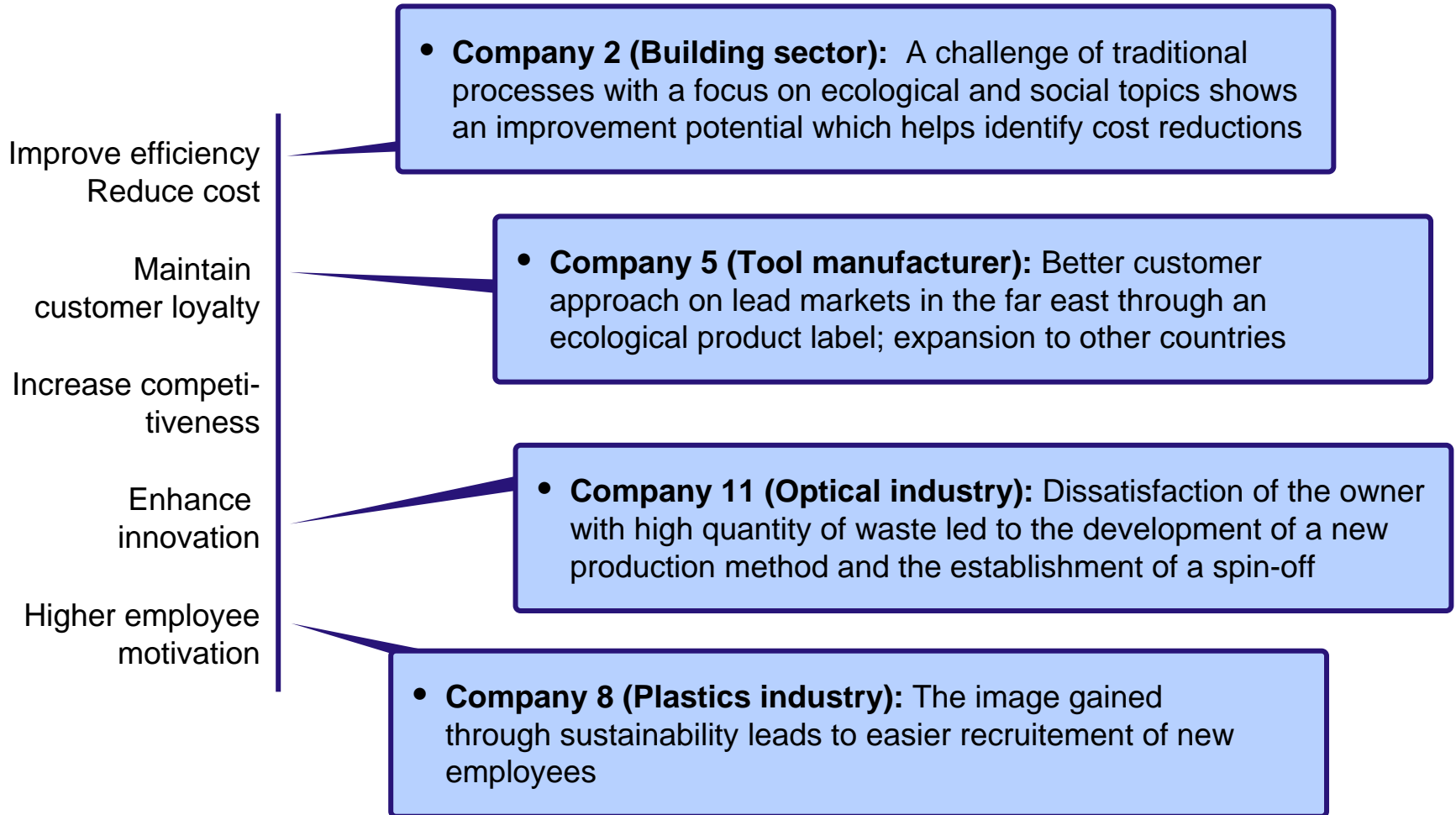


- Sustainability engagement is justified with various individual economic advantages
- Especially **small companies** see a better customer loyalty and a higher employee motivation
- **Companies quoted at the stock exchange** regard cost reduction a the main factor
- Companies in the chemical or power industry engage in order to fulfill legal requirements and to secure their „licence to operate“

* Other information on average 11% (legal conditions, licence to operate, risk management, investor relations)

The main reasons for sustainability engagement lie in cost reduction and a maintained customer loyalty

REASONS FOR SUSTAINABILITY ENGAGEMENT



Sustainability risks and chances have to be analysed specifically for individual branches and companies

PERCEPTION OF CHANCES AND RISKS

Chances

- Differentiation from competitors
- Image benefit & reduction of reputation risks
- Opening of new markets
- Development of better products
- Technology leadership

Risks

- Poor market acceptance
- Too high development costs
- Loss of jobs through higher costs
- Unsolvable problem complexity
- Object of enterprise out of focus

- Sustainability orientation is an entrepreneurial decision with chances and risks
- Chances and risks are specific to the branches and companies
- Systematisation and best-practice-examples should be the subject of further research

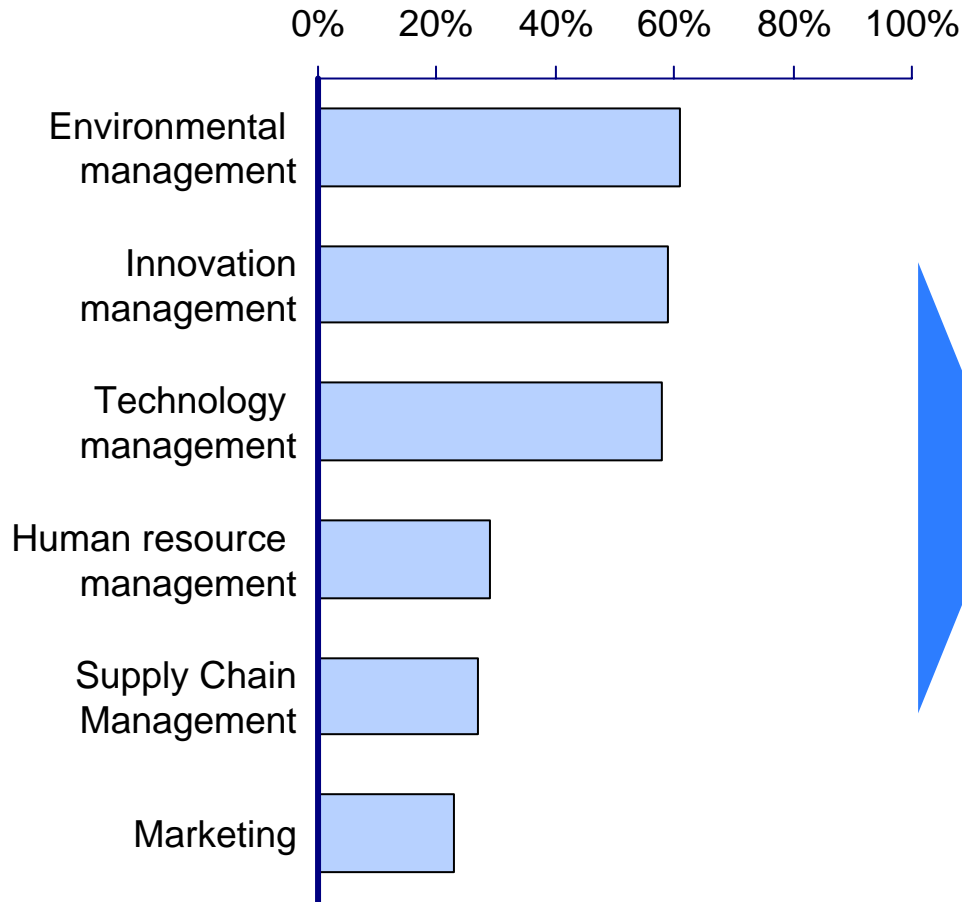
The approach towards the application of sustainability chances differs between individual companies

APPROACH TOWARDS CHANCES AND RISKS

	Company 3 (Electronics industry)	Company 2 (Building industry)
Strategy	<ul style="list-style-type: none">• Economic sustainability a central strategic theme, ecological and social issues have mainly a „cosmetic character“	<ul style="list-style-type: none">• Integral consideration of sustainability is the central strategic theme
Processes	<ul style="list-style-type: none">• Continuous economic improvement as a process and target	<ul style="list-style-type: none">• Systematic sustainability challenge of all internal processes
Tools	<ul style="list-style-type: none">• Primarily use of general management tools (e.g. scenario analysis)	<ul style="list-style-type: none">• Application of sustainability tools (material intensity, life-cycle analysis) for a structured search of innovation possibilities
Innovations	<ul style="list-style-type: none">• Rather „accidental“ identification of innovation possibilities, yet different products have an implicit sustainability connection	<ul style="list-style-type: none">• Changing customer needs are regarded as a systematic chance to differentiate own products

Sustainability is strongly linked with the themes technology and innovation, marketing plays a subordinate role

MEANING OF SUSTAINABILITY FOR OTHER CONCEPTS*

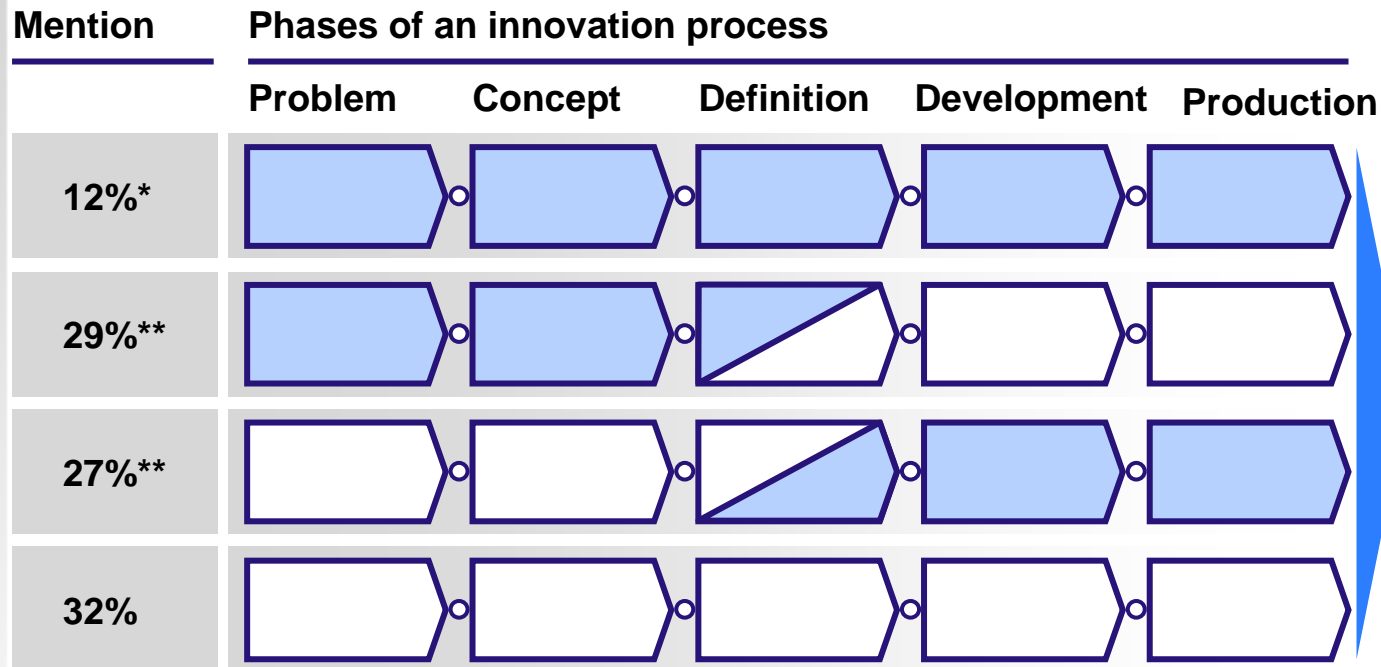
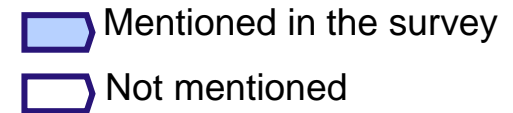


- **Bigger companies** see a clear connection between sustainability and environmental management
- **Smaller companies** are more likely to emphasise technology and innovation management
- Objectives of sustainability integration in **innovation processes** are **technology leadership, addressing new customers and a better image**

* other information average 13 % (Financemanagement, Knowledgemanagement, Corporate Governance, Change Management)

Only few companies take sustainability criteria explicitly into account during all phases of their innovation processes

SUSTAINABILITY CRITERIA IN INNOVATION PROCESSES



- Consideration of sustainability varies a lot
- ~ 60% of all businesses do not consider sustainability in the early innovation phases
- Yet early phases are especially important for successful innovations

* Criterion: min. 4 nominations out of the 5 named phases

** Criterion: min. 2 nominations out of 3 phases

The approach to integrate non-economic criteria differs between companies and branches

EXAMPLES FOR SUSTAINABILITY CRITERIA

Phases in the innovation processes

Problem Concept Definition Development Production



Typically conforming to legal demands

- **Company 11 (Optical Industry):**
Vision driven problem definition (e.g. no use of dangerous materials)
- **Company 2 (Building industry):**
Analysis driven problem definition (e.g. weak point analysis with an ecobalance)

Company 5 (Tool manufacturer):
Increase of productivity and reduction of environmental pollution as simultaneous innovation targets

Company 6 (Food industry):
Invest assessment with Ecoefficiency criteria and Ecobalances

AGENDA



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Conclusions

There are prominent examples for large end-of-pipe investments that could have been avoided

ILLUSTRATIVE EXAMPLES AND MOTIVATION

Kronos-Titan, 1989:

Upon severe public pressure, constructed a 100 M\$ facility to recover spent sulfuric acid that used to be dumped in the North Sea

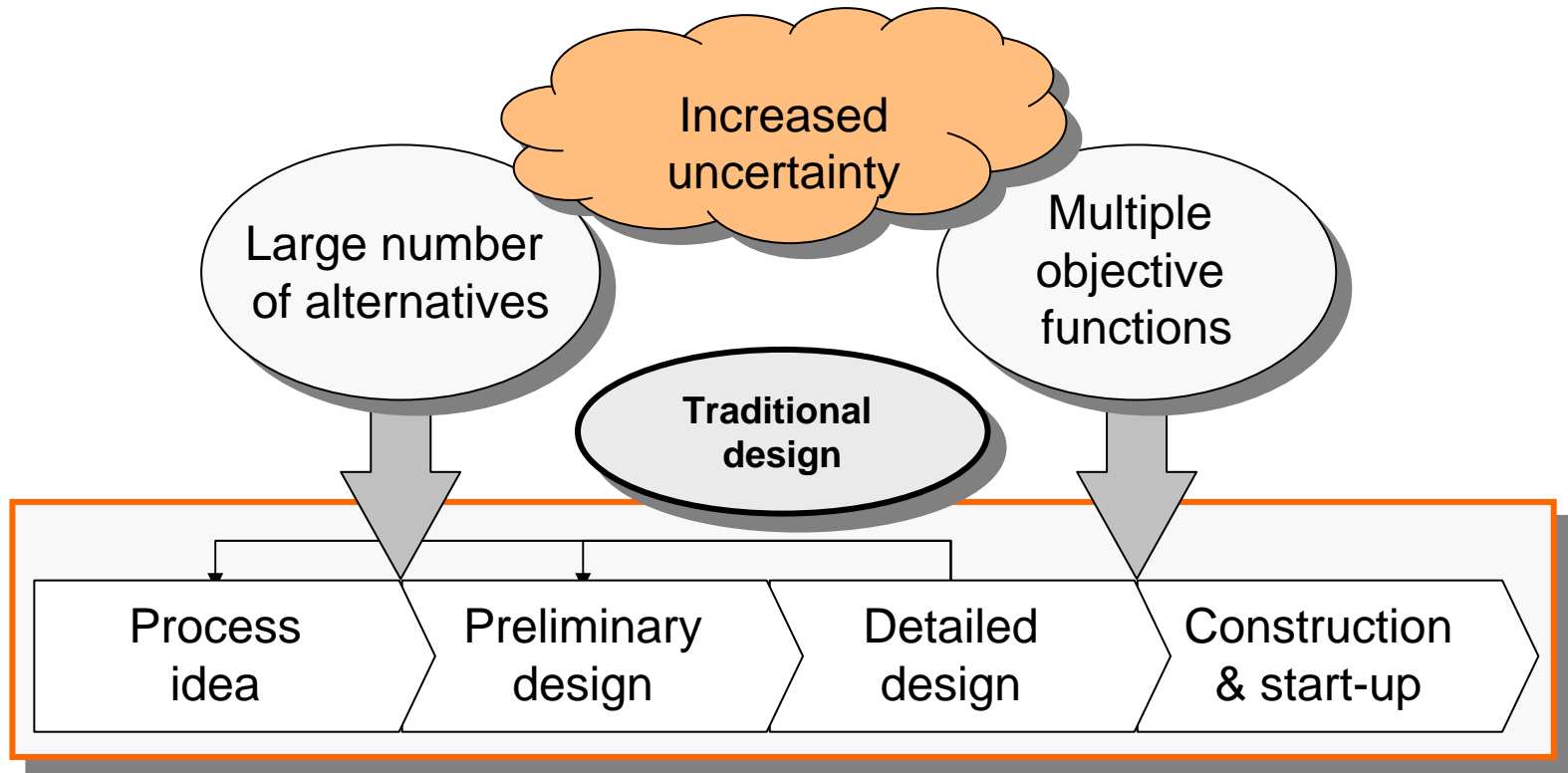
American Cyanamid, 1992:

Launched a 50 M\$ project to install emission recovery units after having been the biggest polluter in the US for several consecutive years

Imagine being the CEO of those companies...
Could your company have performed better with a more thoughtful design and selection of the original technologies?

The traditional process design approach does not appropriately address current challenges

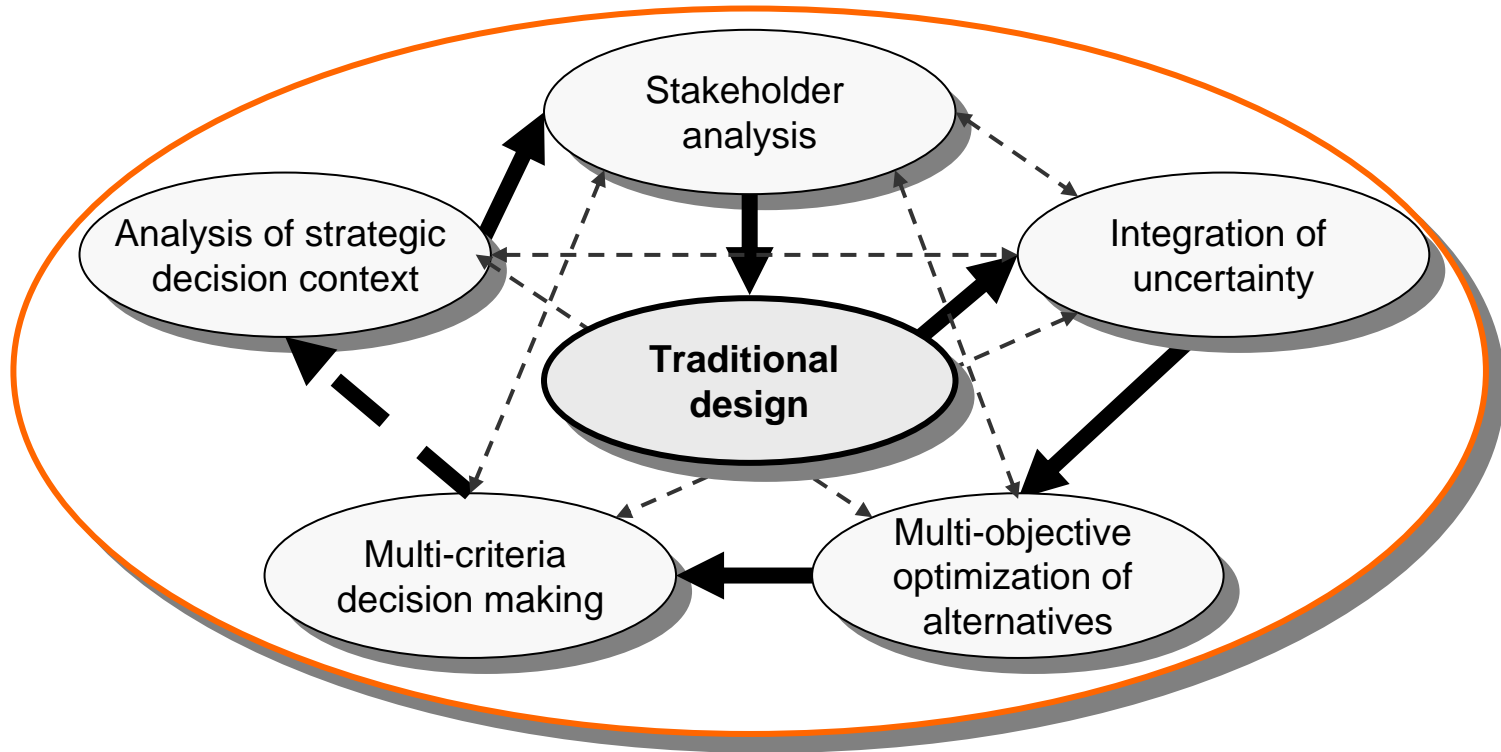
TRADITIONAL DESIGN FRAMEWORK



Traditional design objective:
Identify and build the most profitable technology while accepting environmental and social requirements as constraints

The extended approach to technology design explicitly integrates key issues for building sustainable technologies

EXTENDED DESIGN FRAMEWORK

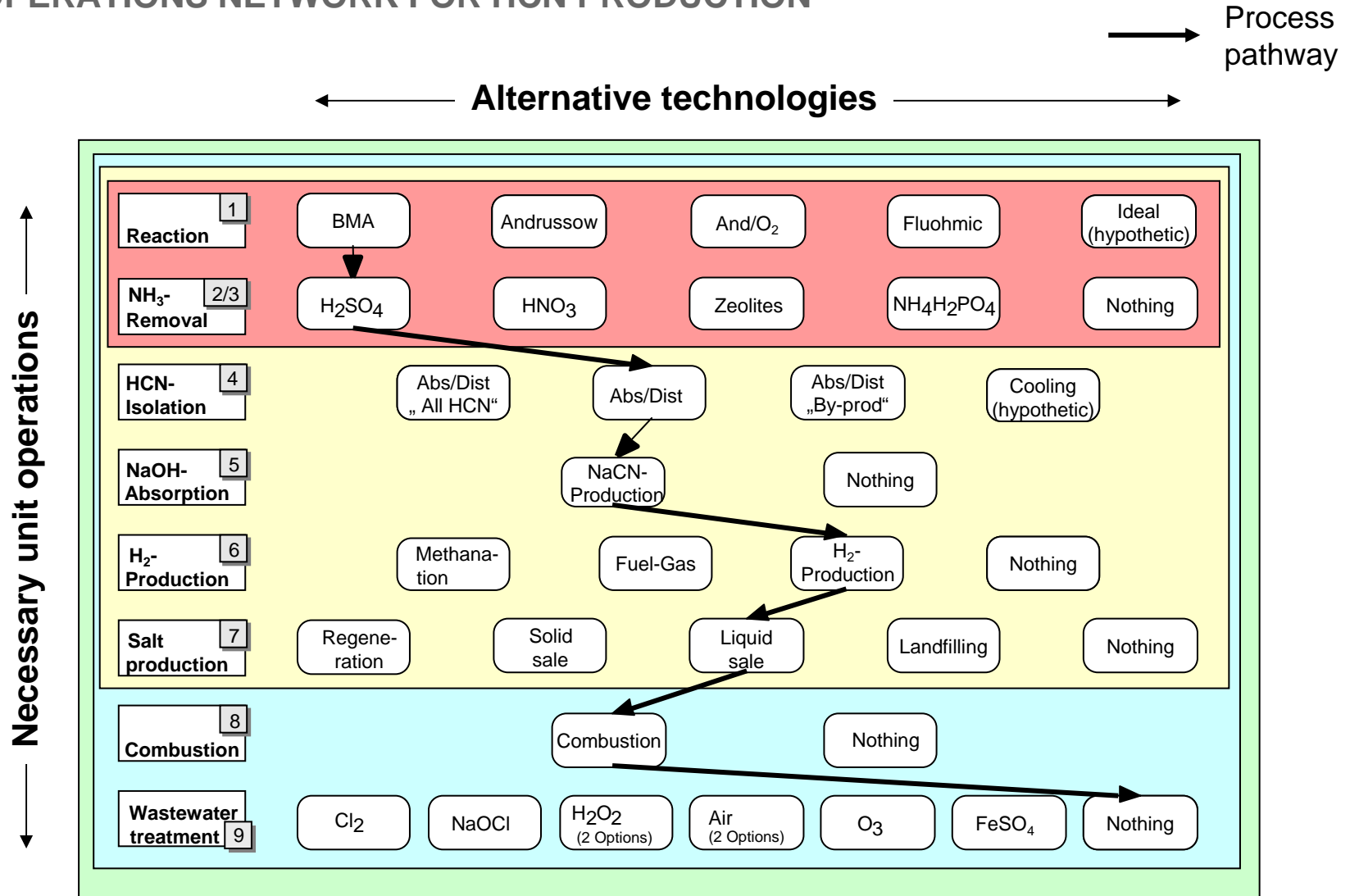


Modern design objective:

Identify and build the most **sustainable** technology – a technology that generates lasting profits while observing current and future environmental and social objectives

Which of more than 70.000 "reasonable" and over 1.000 technically feasible alternatives should you choose?

UNIT OPERATIONS NETWORK FOR HCN PRODUCTION

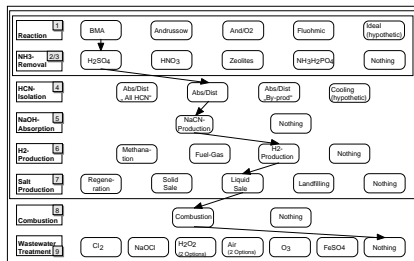


With a systematic technology screening the number of process alternatives can be reduced significantly

SOLUTION STRATEGY: TECHNOLOGY SCREENING

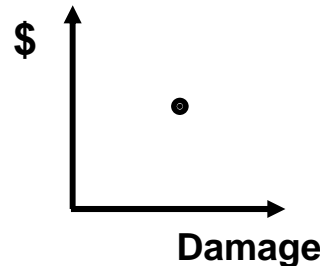
Technology superstructure

- Roughly model all 'reasonable' alternatives
- Compute material flows for each *feasible* alternative



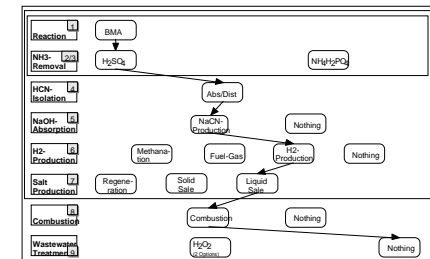
Multi-objective evaluation

- Evaluate each alternative with sustainability indicators, e.g., economically and environmentally



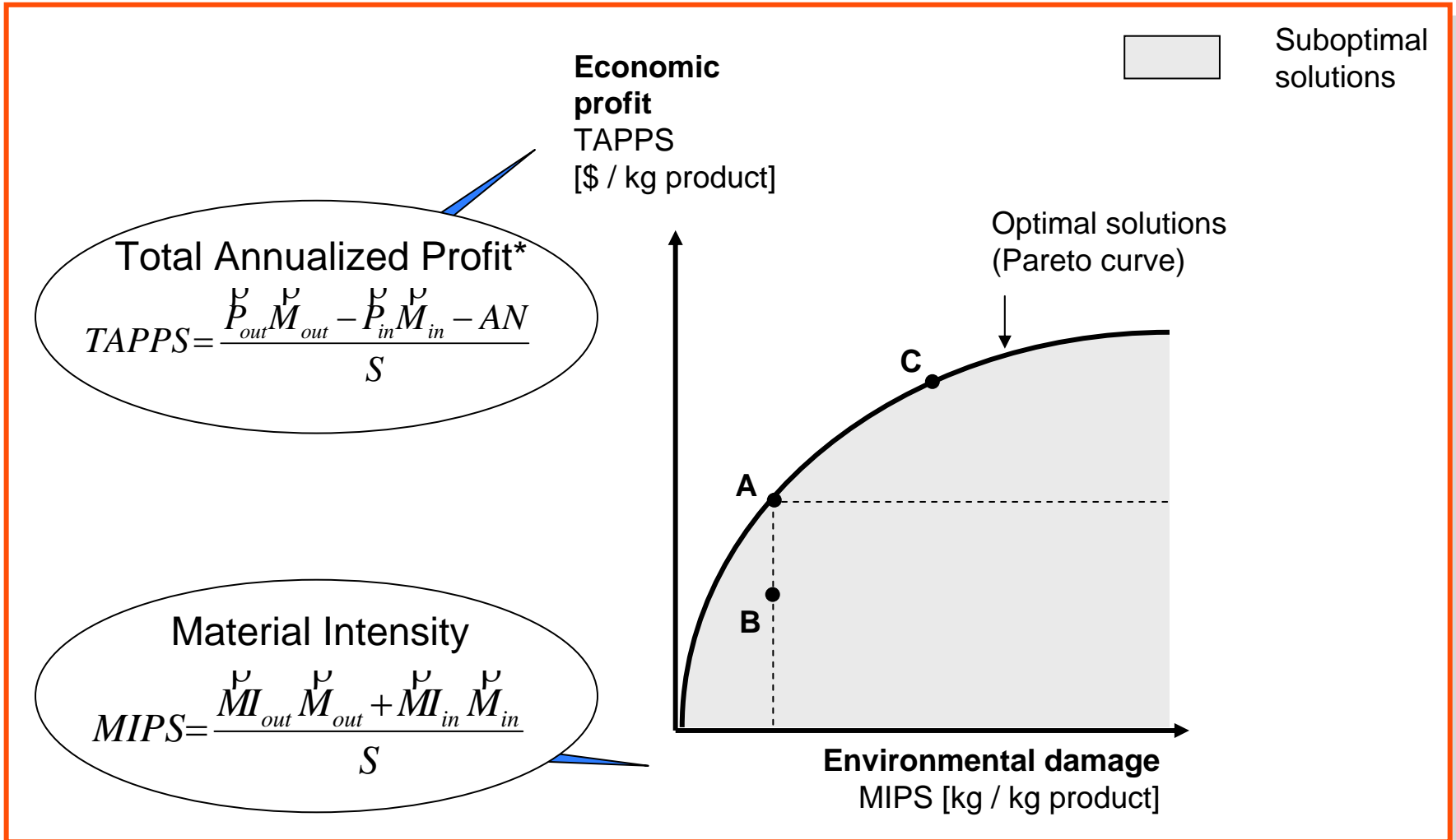
Process pre-selection

- Include most promising alternatives in further analysis for a detailed design



A Pareto graph visualizes optimal process alternatives as points that are located on the Pareto curve

PARETO GRAPH WITH ECONOMIC AND ENVIRONMENTAL OBJECTIVES

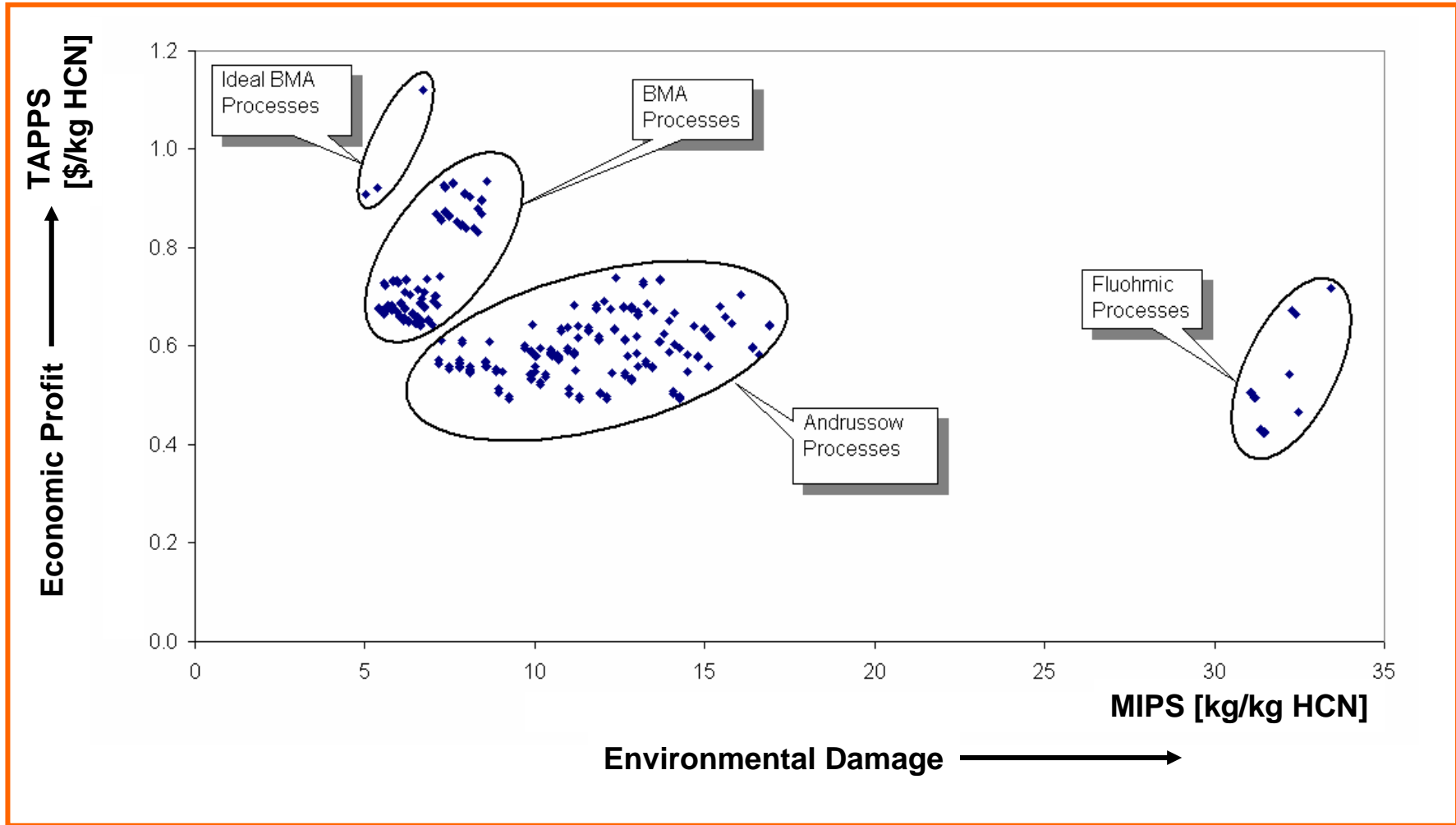


* P_i price, M_i material flow, AN annuity, M_i material intensity

** Costs for operations and maintenance not included

In HCN production the choice of the reactor type is a key decision that determines sustainability

PARETO GRAPH FOR SCREENING HCN-TECHNOLOGIES



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CONCLUSIONS

- The results of sustainability considerations often lead to an asymmetrical profile of **chances and risks** which affect companies differently
- **Chances** result especially through **differentiations** in saturated markets, **through opening of new markets and technology leadership**
- The field of chances and risks requires an **individual consideration for the single businesses and branches**. From the scientific viewpoint the chance-risk-field should be analysed in a more structured and detailed way.
- Regarding technical innovations, a **new design paradigm seems necessary** that explicitly considers stakeholders and multiple objectives