

# Assessment tools of treatment concepts for contaminated dredged sediments

---

**Kay Hamer, University of Bremen**

**1. Principles of Assessment**

**2. Environment**

**assessing products (methods)**

**assessment on different scales**

**(treatment units – treatment chains – river basin scale)**

**sustainability: time and space**

**3. Economy**

**4. Society**

**5. Recommendations**

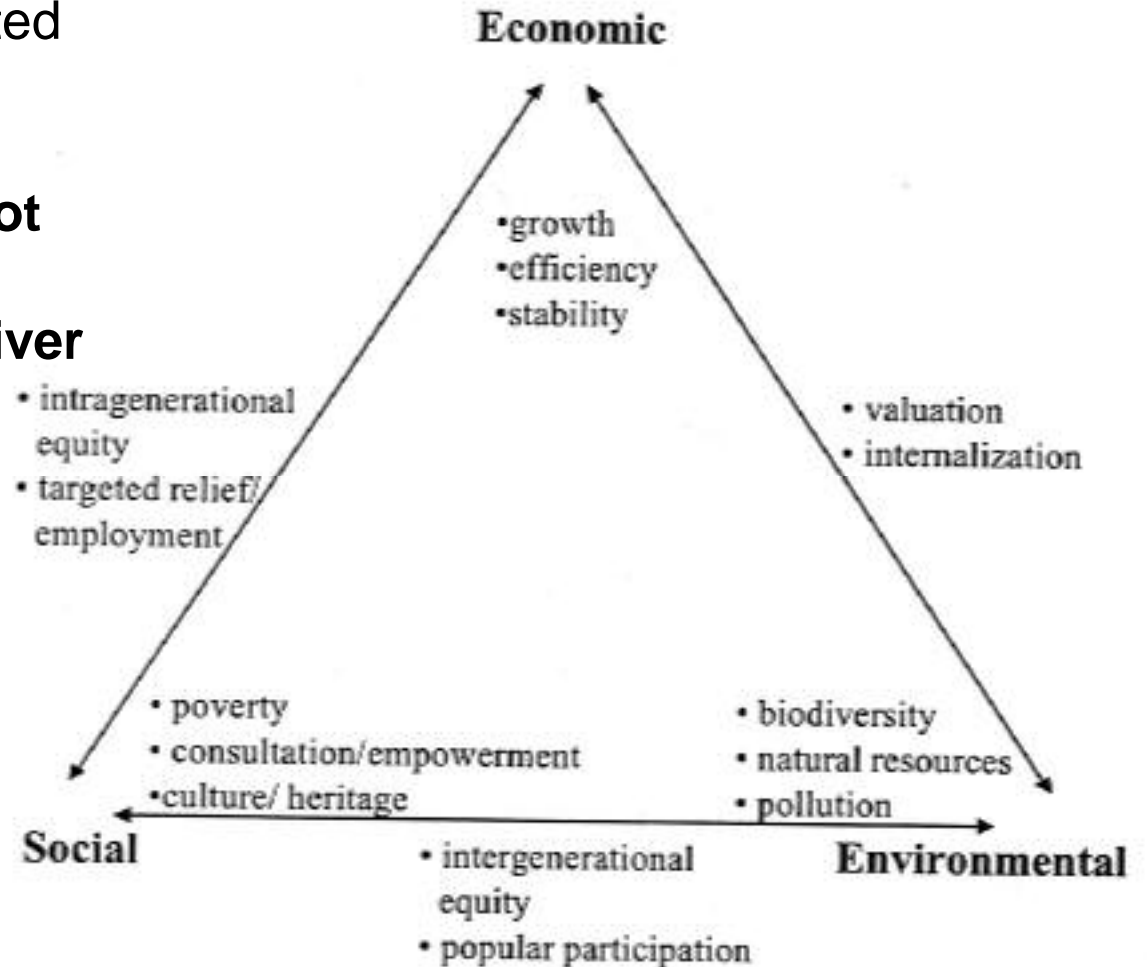
**6. Acknowledgements**

**Sed  
Net**



# 1. Principles: Assessment of treatment chains.....

**“Environmental, economic and social aspects must be integrated in a river basin view and interventions like dredging or disposal of sediments should not result in unwanted impacts elsewhere or any time in the river basin. “**



## 2. Environment: What should be considered?

---

environmental assets to be protected are:

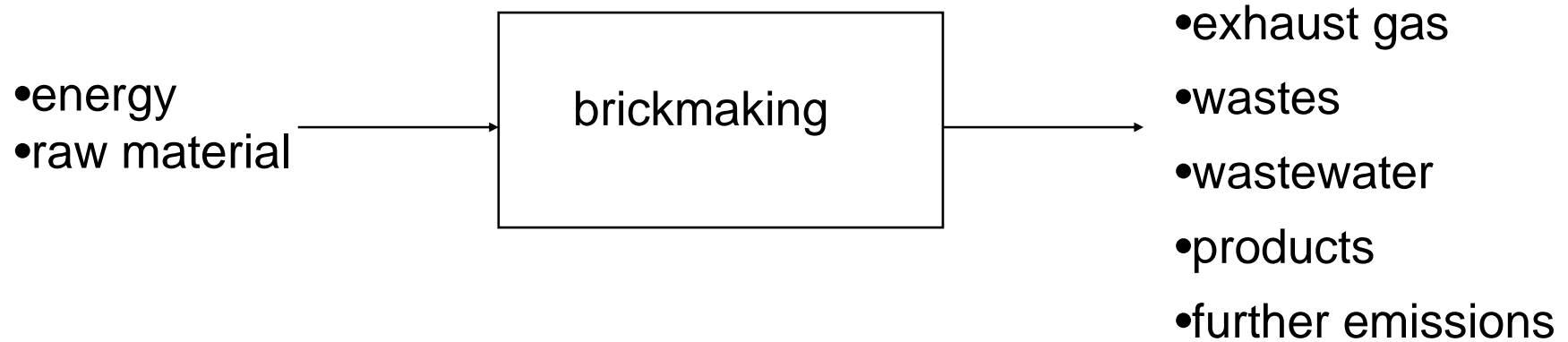
- human beings, animals and plants
- soil, water and air
- climate and landscape
- cultural heritage
- mutual interaction that may occur

European Environmental Impact Assessment Directive; EC 1997; 97/11/EC and EC 1985; 85/337/EC



## 2. Environment: Assessment of products

---



regulations about emissions, waste, products etc.



different methods to investigate products and wastes



## 2. Environment

### 2.1 Methods to investigate products and wastes

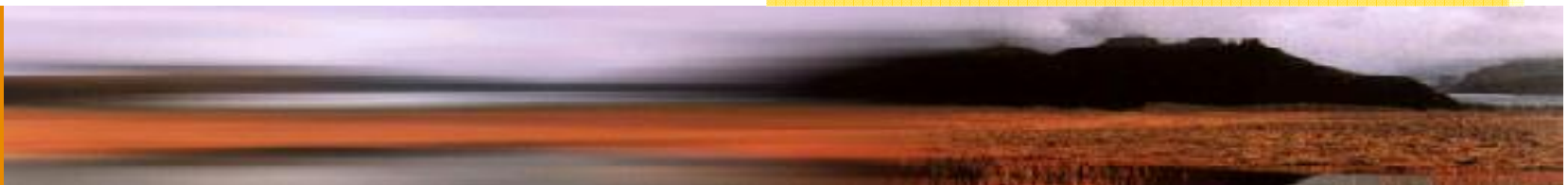
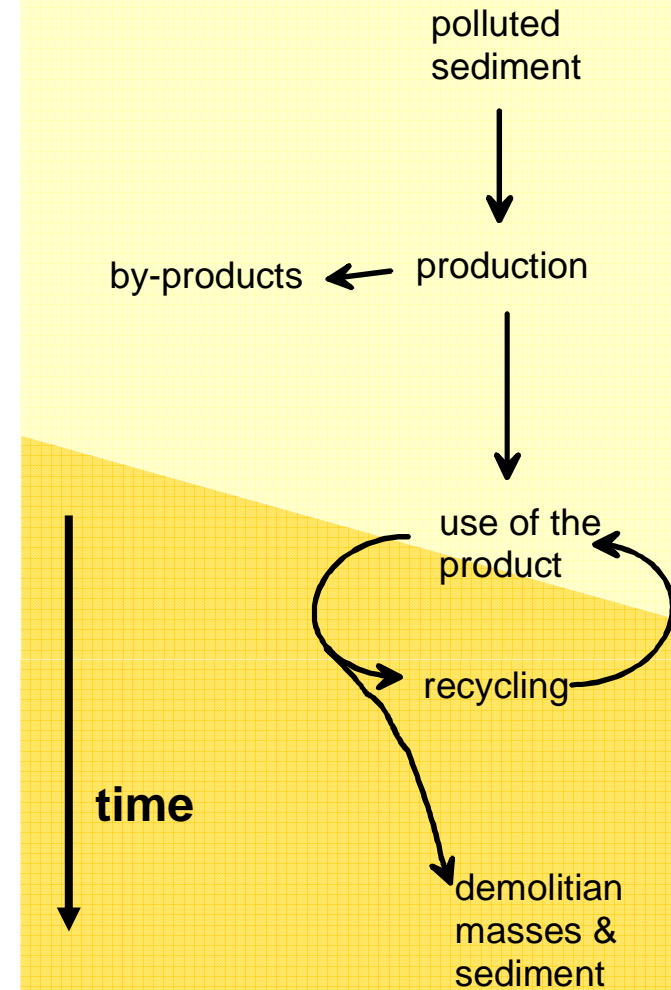
boundary conditions can change with time:

- weathering
- pH/Eh-values
- grain size
- percolation
- etc.

**Environmental tests should include AGING EFFECTS:**

- **Re-use**
- **changes in the physical & chemical circumstances**

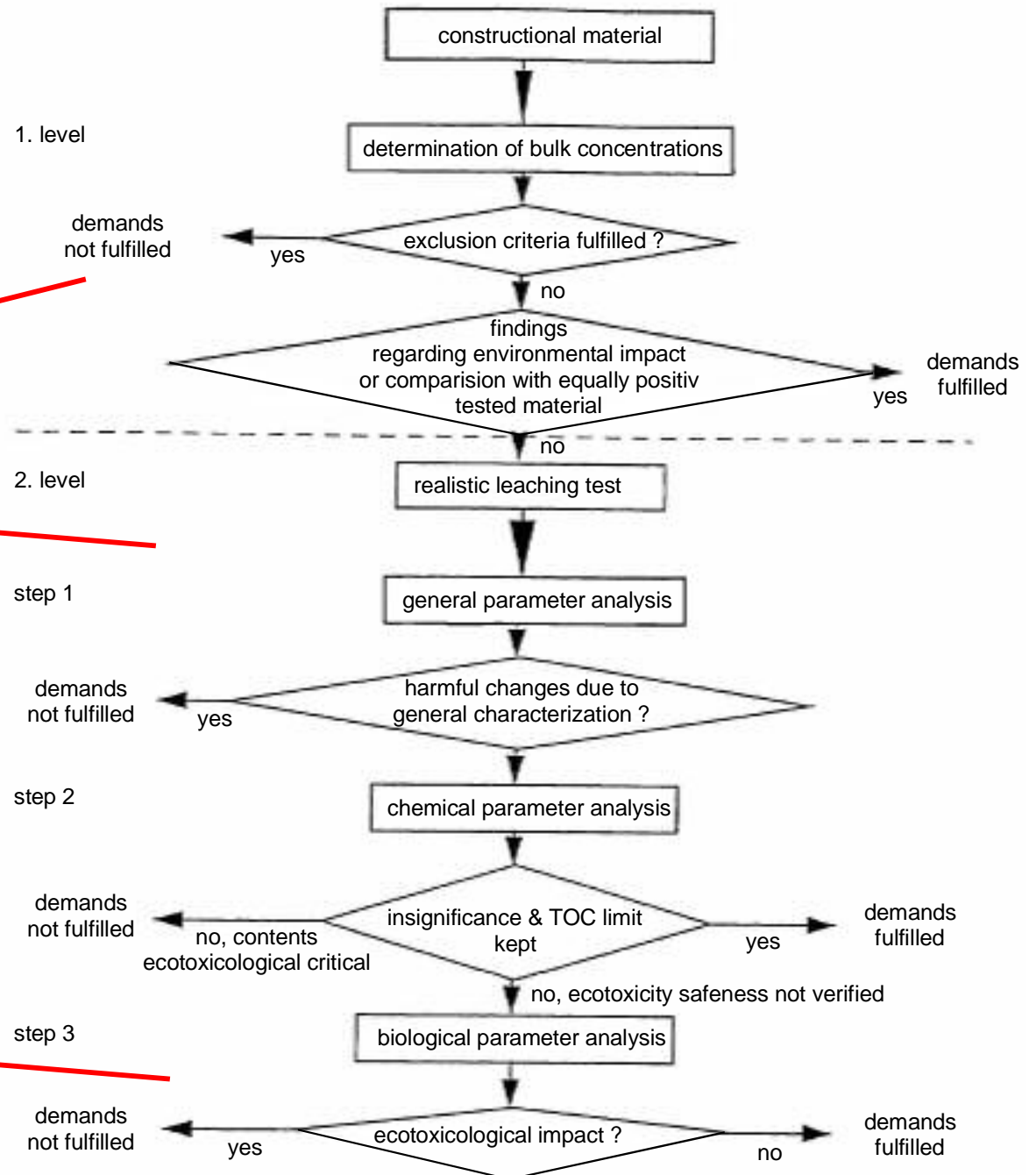
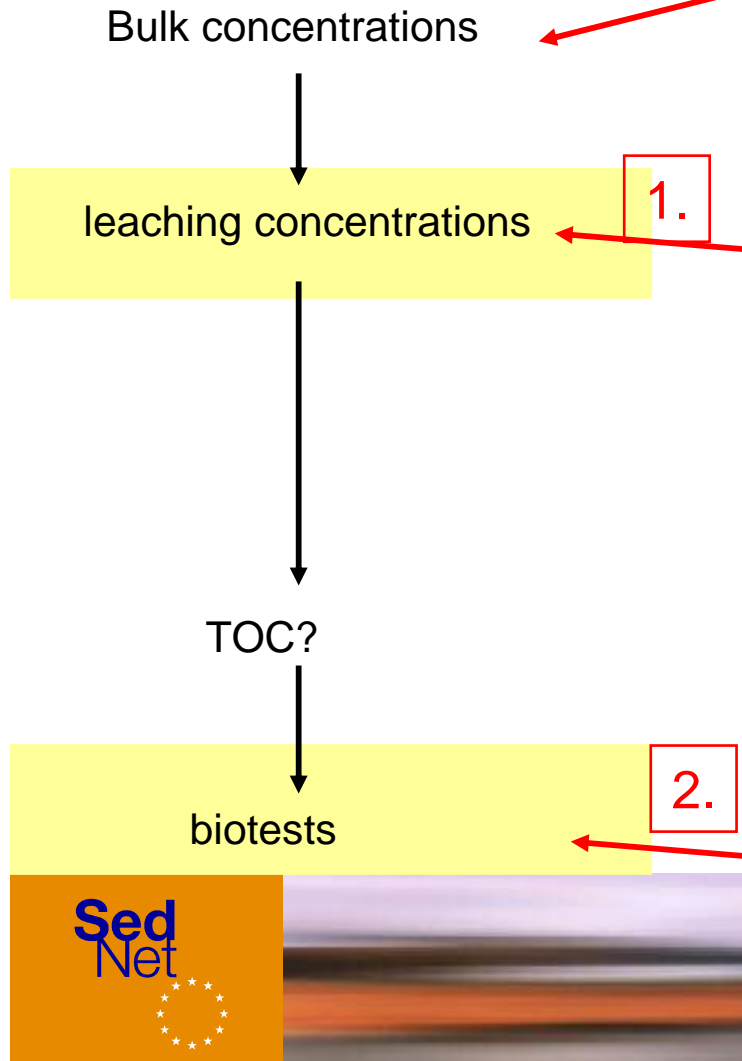
#### Life-cycle of products



## 2. Environment

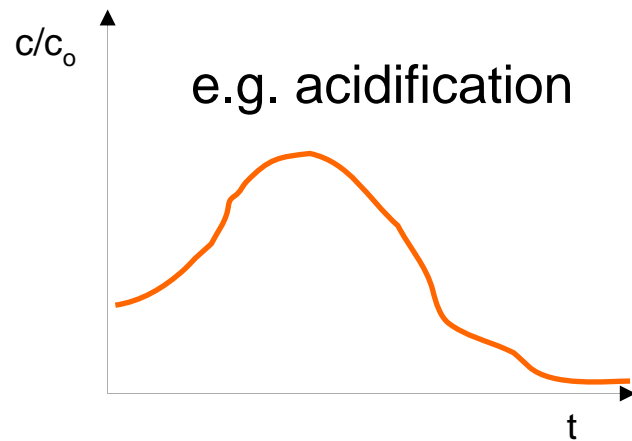
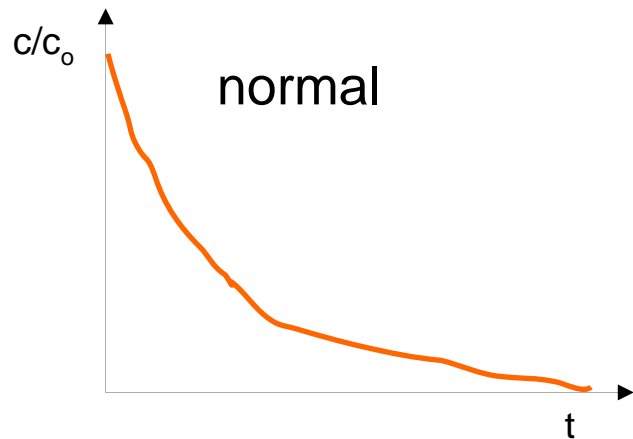
### 2.1 Methods

#### Investigation on Building Material, DIBt, 2001

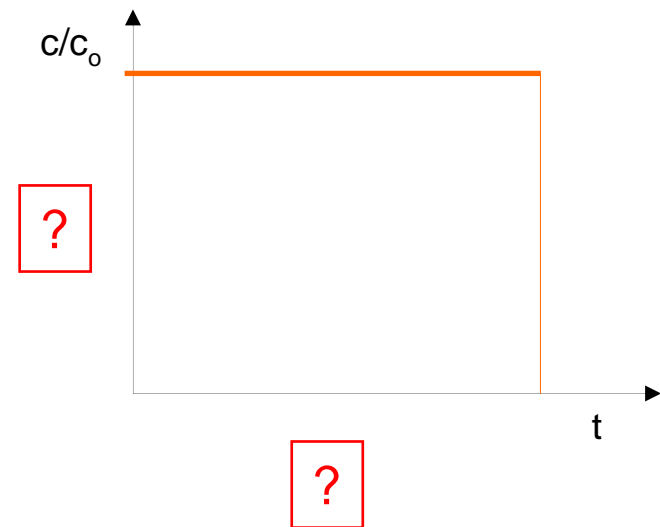


## 2. Environment

### 2.1 Methods - leaching

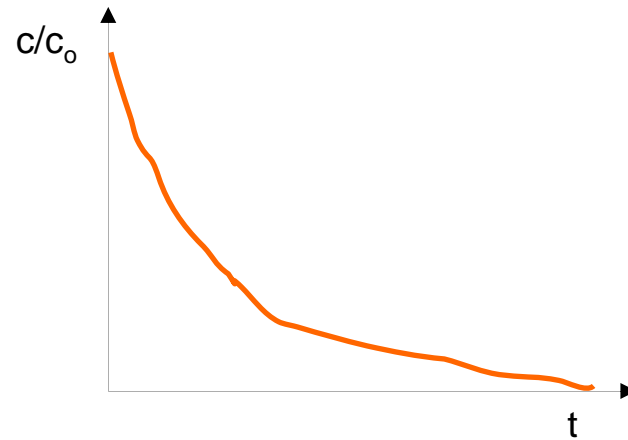
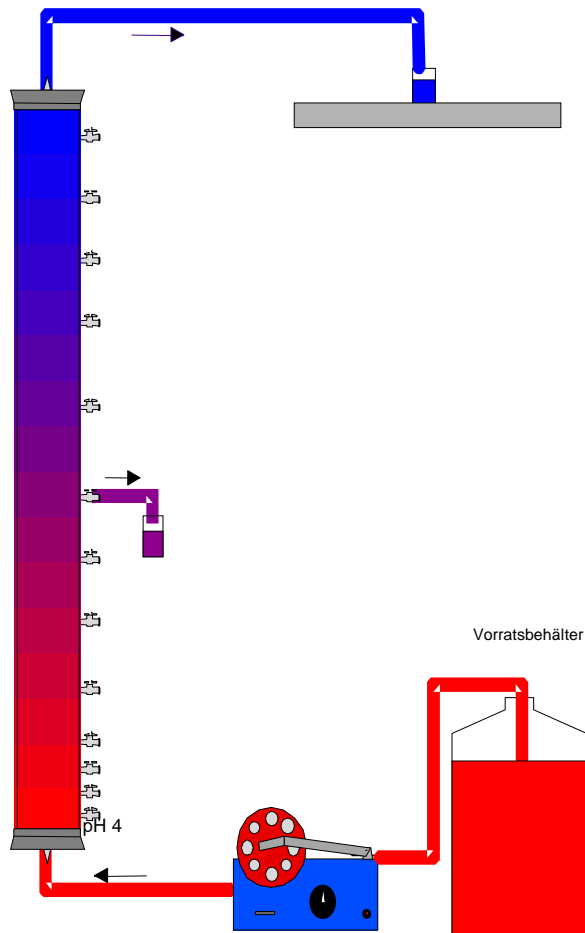


problem of  
single leaching tests



## 2. Environment

### 2.1 Methods - leaching



„European network on the harmonisation of leaching“  
Van der Sloot  
[Wwww.leaching.net](http://Wwww.leaching.net)

BMBF-Verbundvorhaben „Sickerwasserprognose“ since 2001

Joint research programm of the Federal Ministry of Education and Science about leaching and transport

Sed  
Net

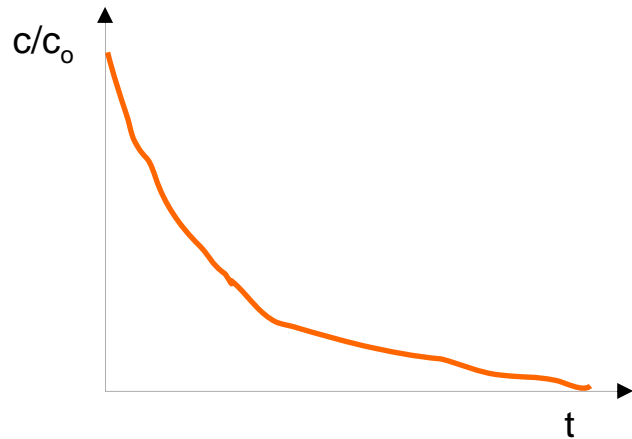




## 2. Frame of assessment

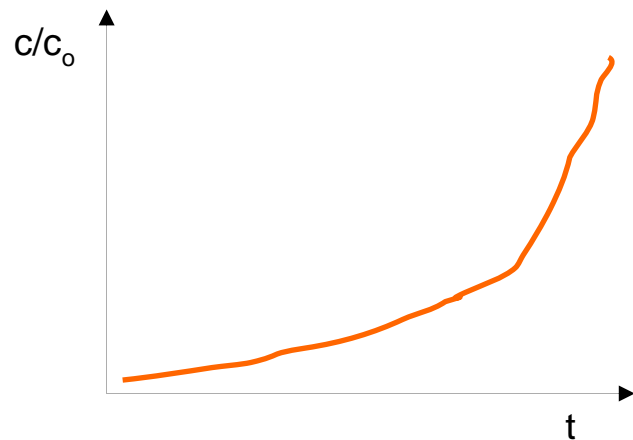
### 2.1 Methods: **Modeling the transport of mobile contaminants**

---



realistic development of concentration  
in layers of treated sediment

e.g. heavy metals in porewater under  
anoxic conditions



Dependent on geochemical milieu:  
pH-buffer, redox-buffer, pore-system

e.g. heavy metals in porewater under  
oxic conditions

(e.g. Salomons & Förstner 1988)



## 2. Frame of assessment

### 2.1 Methods: **Modeling the transport of mobile contaminants**

---

Bulk concentration	potential for risk
Leaching tests	mobility and their dependence on boundary conditions like pH, Eh, grain size, ionic strength etc.
Modelling	sensitivity analyses for mobility and transport modelling

Hensen et al. 1997

Karius, 2003, Battelle conference, Venice

Hamer & Karius, acc. 2004, Mar.Poll.Bull

Sed  
Net

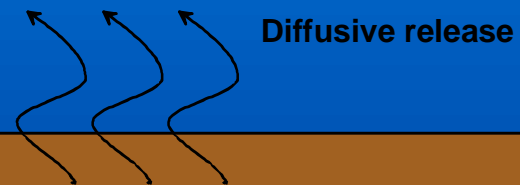


## 2. Frame of assessment

### 2.1 Methods: **Modeling the transport of mobile contaminants**

---

Scenario S1: Diffusion



contaminated

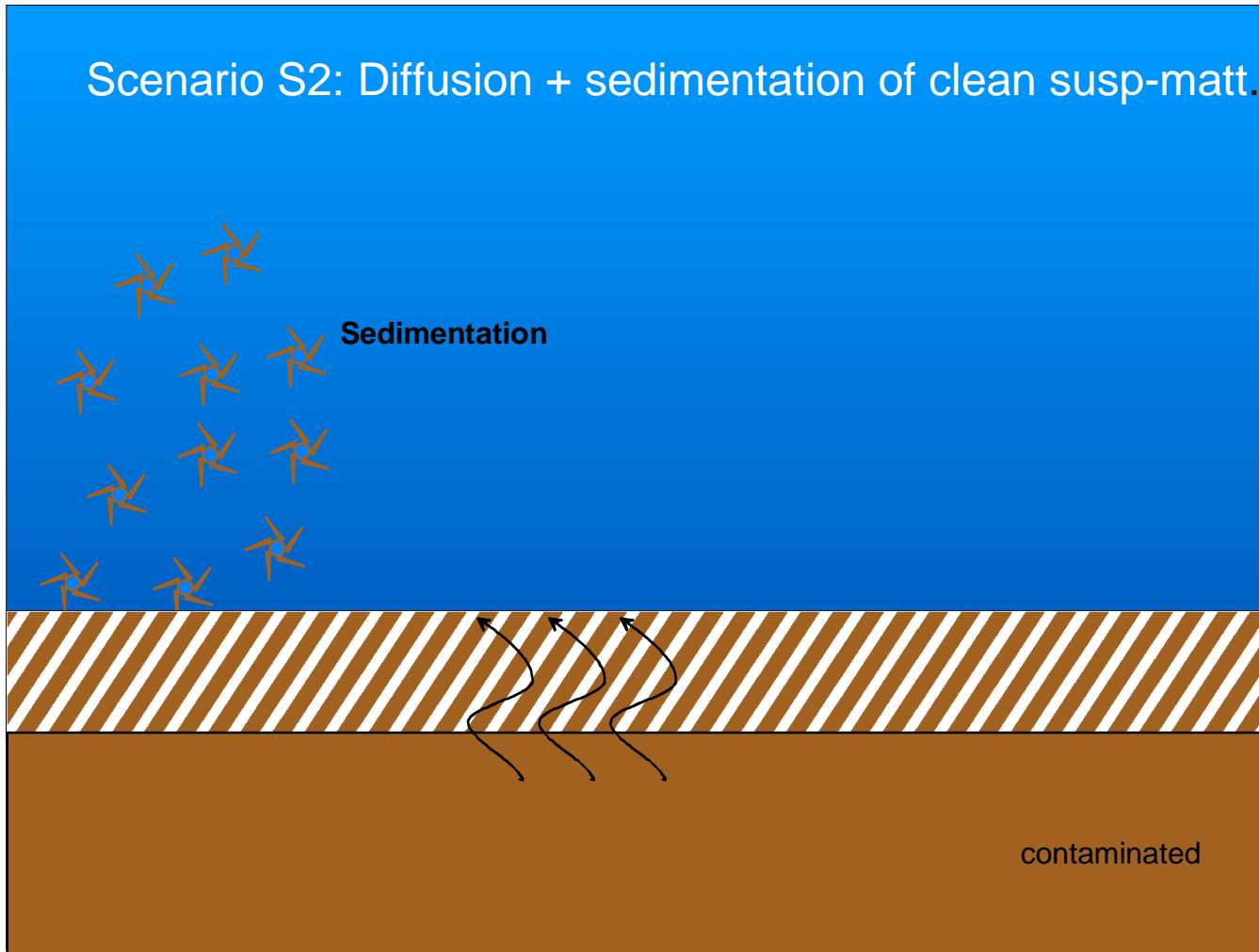
Sed  
Net



## 2. Frame of assessment

### 2.1 Methods: **Modeling the transport of mobile contaminants**

---



Sed  
Net

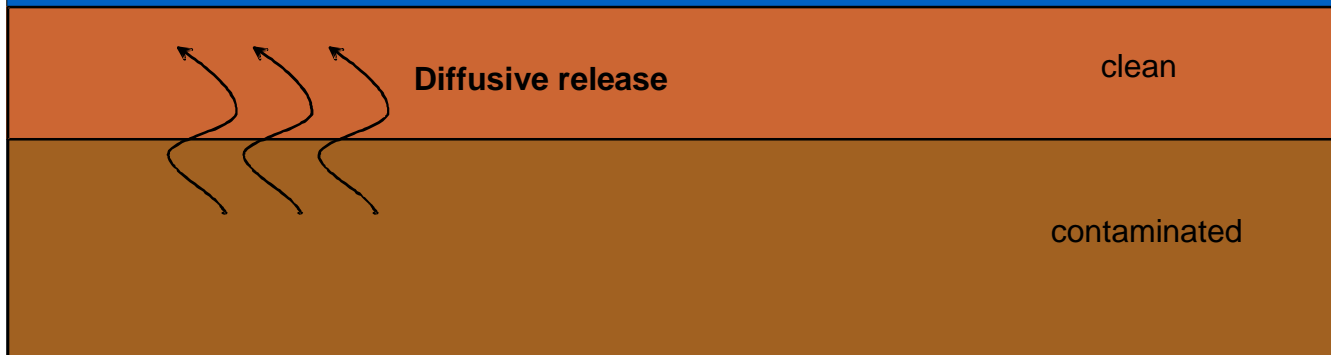


## 2. Frame of assessment

### 2.1 Methods: **Modeling the transport of mobile contaminants**

---

Scenario S3: capping



Considered:

- Diffusion
- Sedimentation
- Capping
- biolirrigation

Aim:

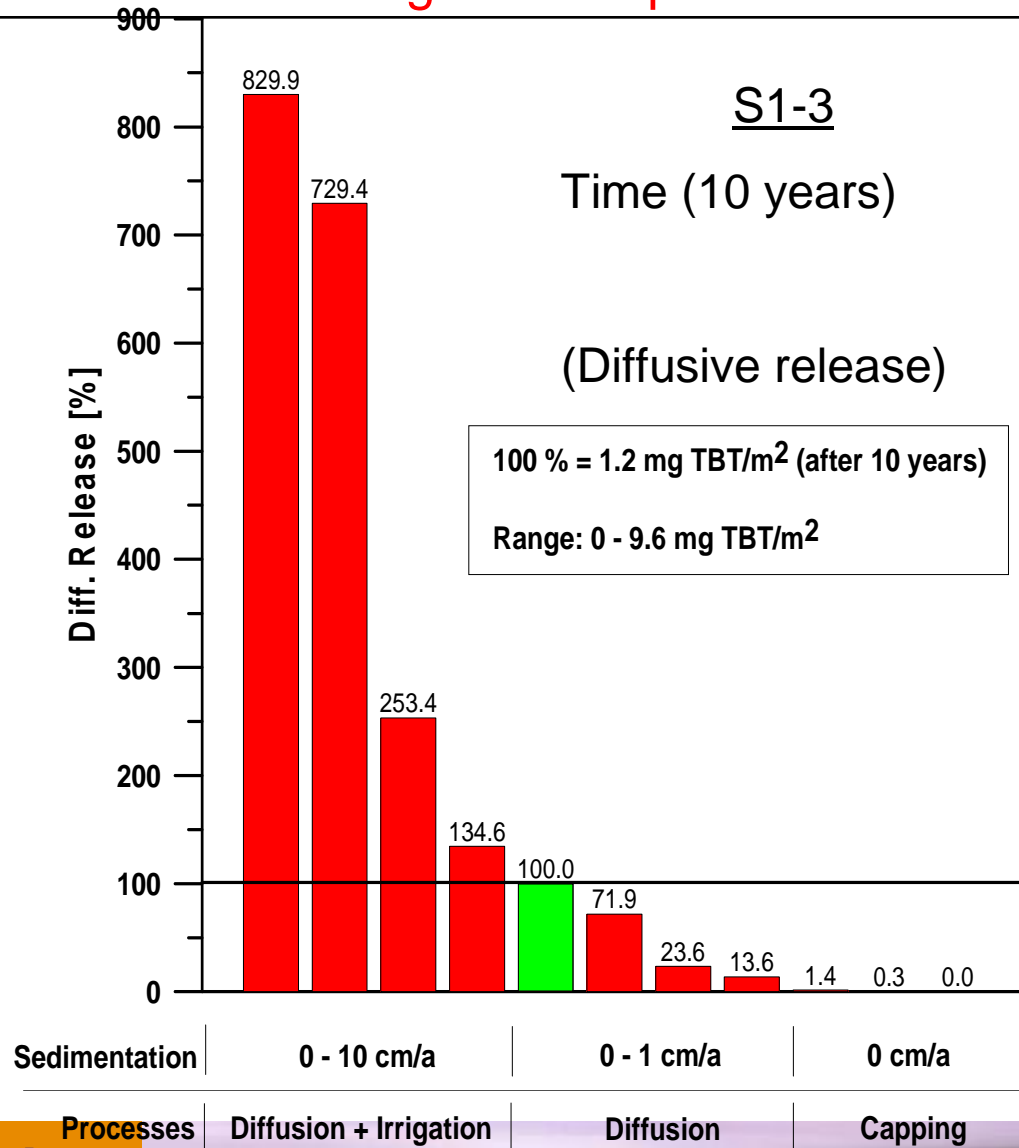
Relevance of different processes & parameter on release of TBT

Sed  
Net



## 2. Frame of assessment

### 2.1 Methods: Modeling the transport of mobile contaminants

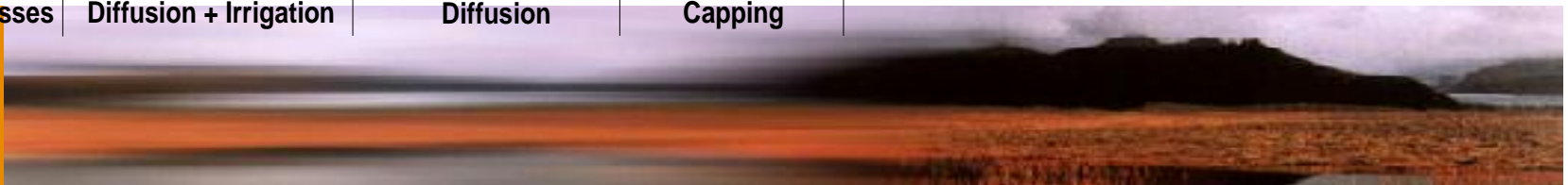


### Conclusion

sedimentation helpful but contradicted by irrigation

capping very effective

- irrigation
- reactive capping?



## 2. Environment

### 2.1 Methods - biotesting

---

Aim of assessment:

- to avoid unwanted effects on assets to be protected

problem of measuring bulk concentrations and leaching:

- chemicals not on the priority list (e.g. TBT years ago)
- synergistic effects
- bioavailabilty

Recommendation:

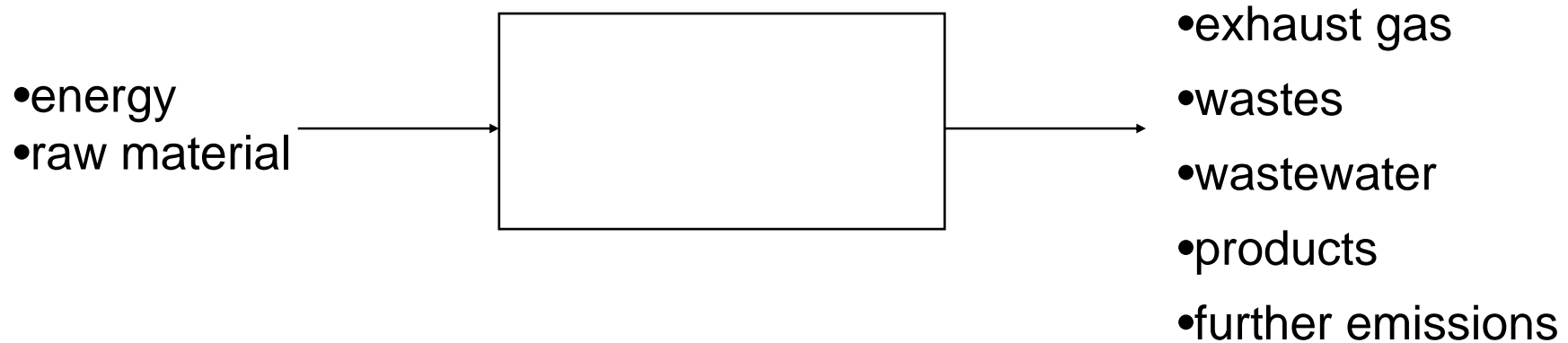
- application of bioassays in combination with bulk concentration/leaching-tests may avoid negelection of synergistic effects and consider bioavailability
- systematic research about reliable combination of methods



## 2. Environment: **Assessment on different scales**

### 2.2 Treatment units

---



•general technical & environmental feasibility as far as threshold-values are concerned

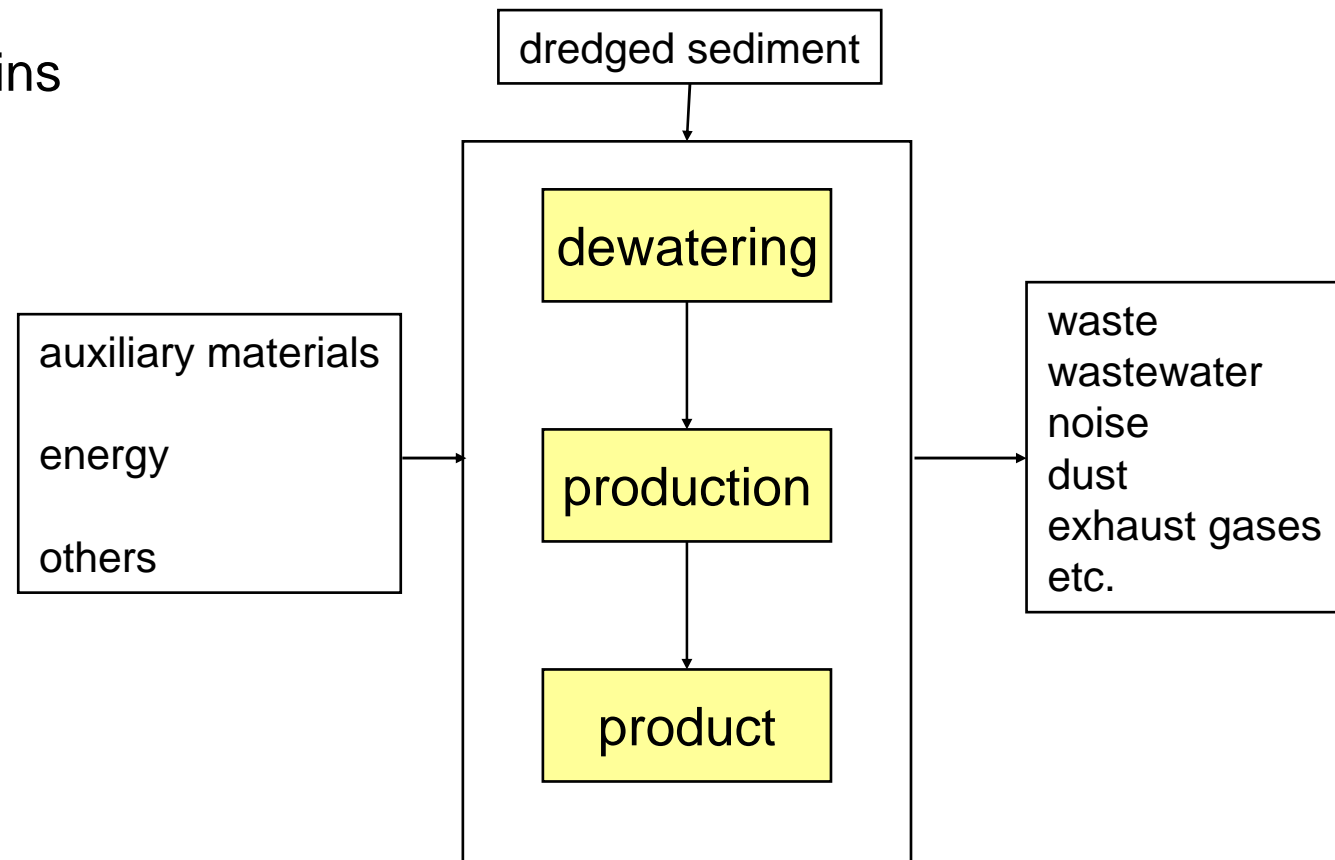
—————> treatment chains





## 2. Environment: **Assessment on different scales**

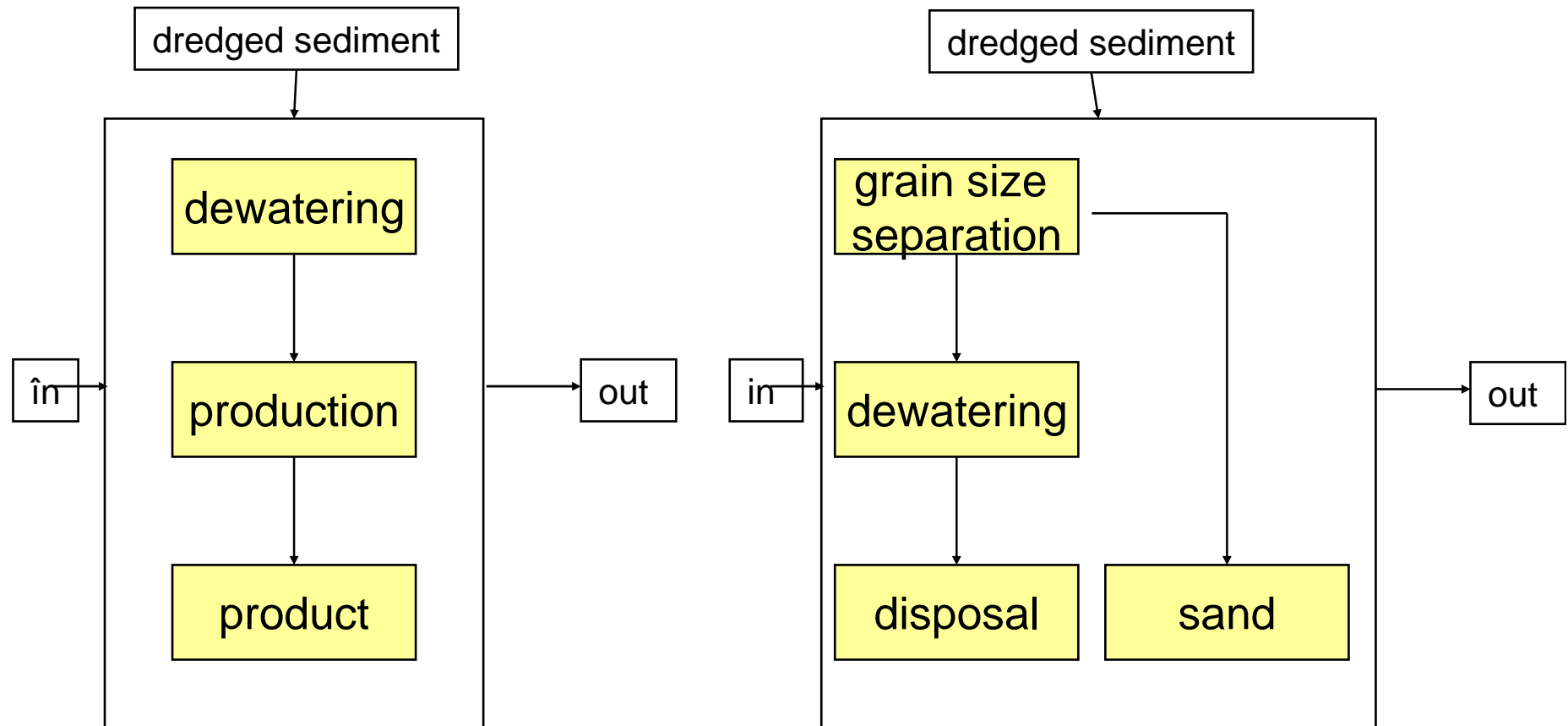
### 2.2 Treatment chains



- technical criteria
- environmental criteria
- acceptable solution for society
- costs



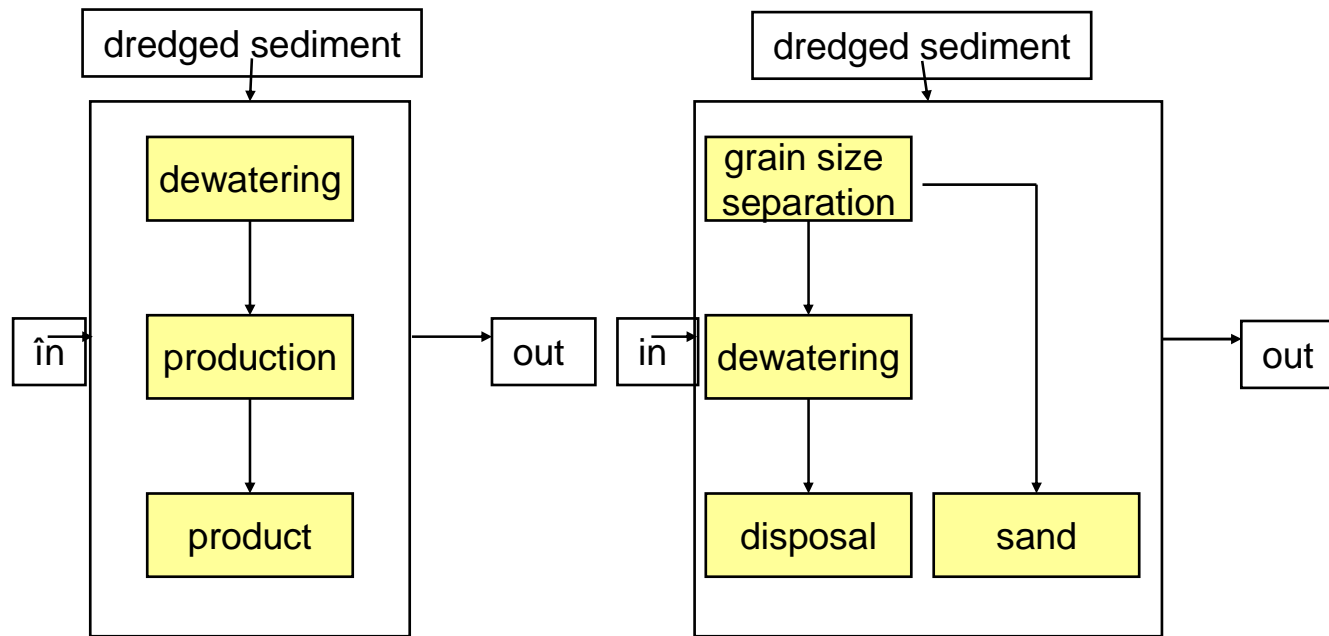
## 2.2 Environment - Assessment on different scales



comparison on a site specific scale (plant scale)



## 2.2 Environment - Assessment on different scales



non-considered on a plant scale:

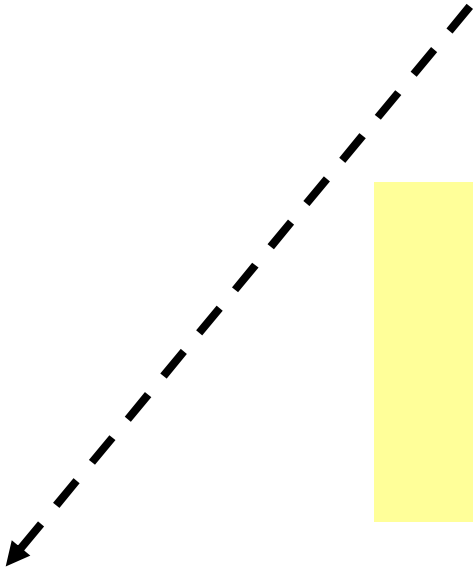
- space consumption
- resource depletion; reuse of sediments instead use of primary resources
- climate
- mutual interactions



## 2.2 Environment: **Assessment on different scales**

---

“Environmental, ..... and interventions ..... should not result in unwanted impacts **elsewhere** or any time **in the river basin.**”

- 
- space consumption
  - resource depletion; reuse of sediments
  - climate
  - mutual interactions

River Basin Scale

time scale?

Sed  
Net

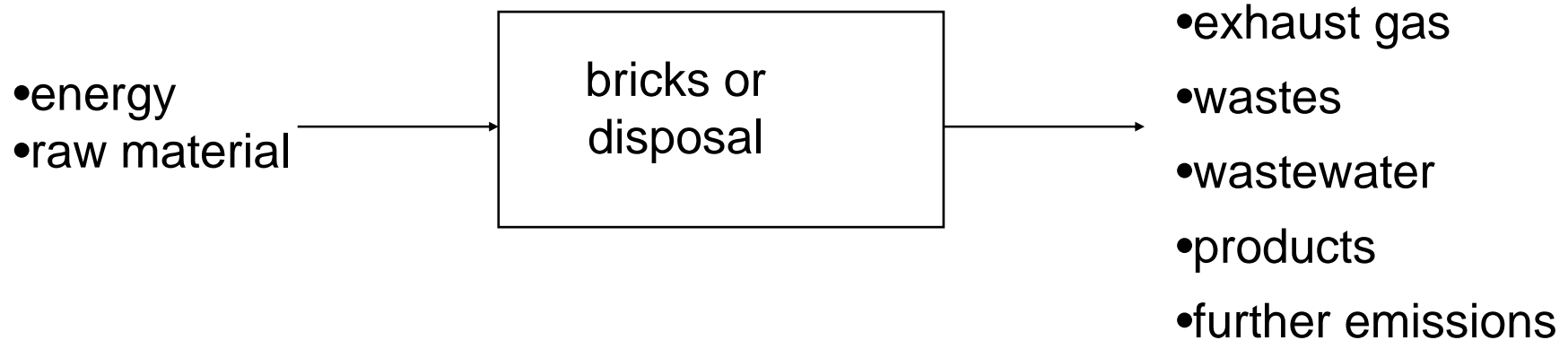


## 2.2 Environment: assessment on different scales

---

statement: brickmaking consumes more energy than disposal

assessment on a treatment unit scale: **yes!**



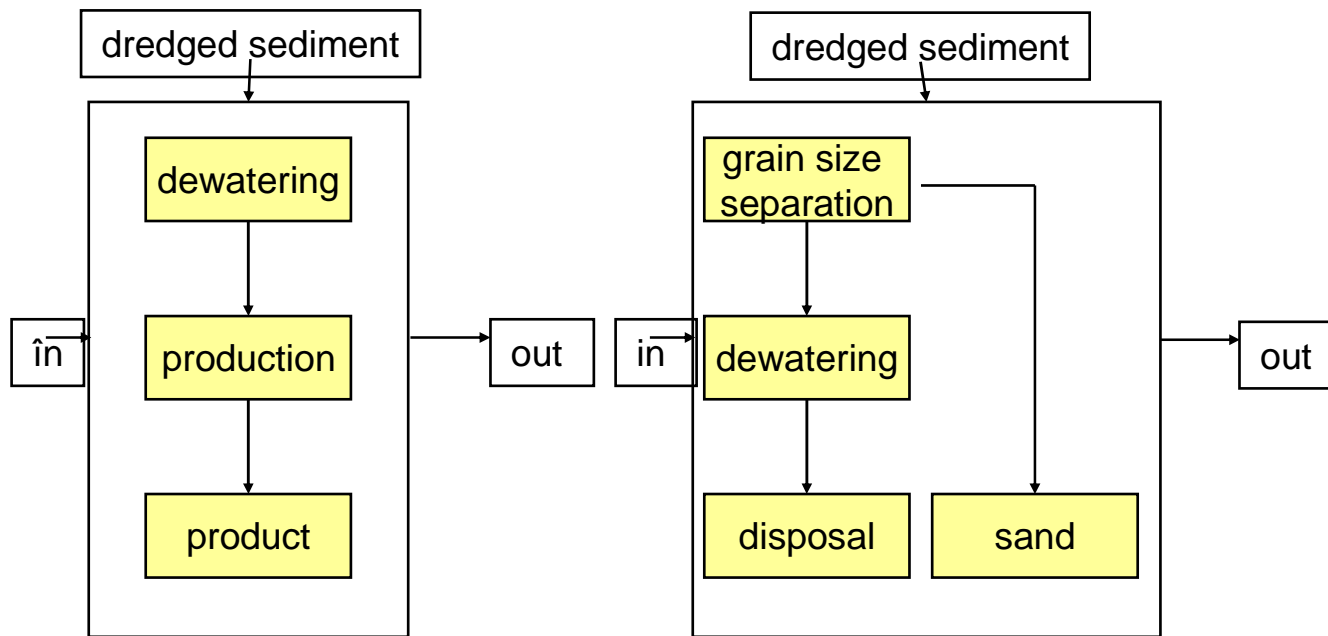
## 2.2 Environment: comparing treatment chains assessment on different scales

---

statement: brickmaking consumes more energy than disposal

assessment on a treatment unit scale:                      yes!

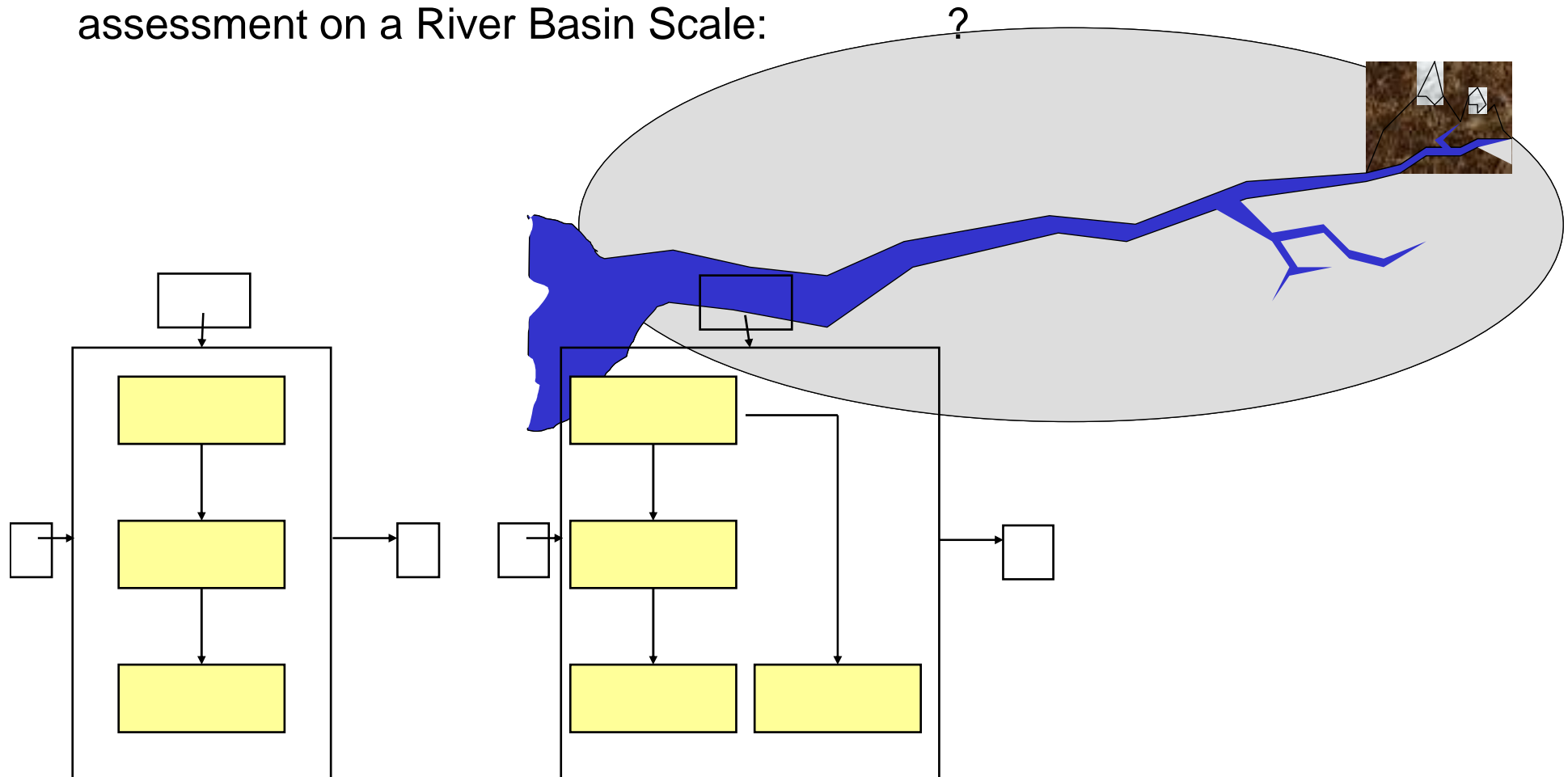
assessment on a treatment chain scale:                      **yes!**



## 2.2 Environment: comparing treatment chains assessment on different scales

statement: brickmaking consumes more energy than disposal

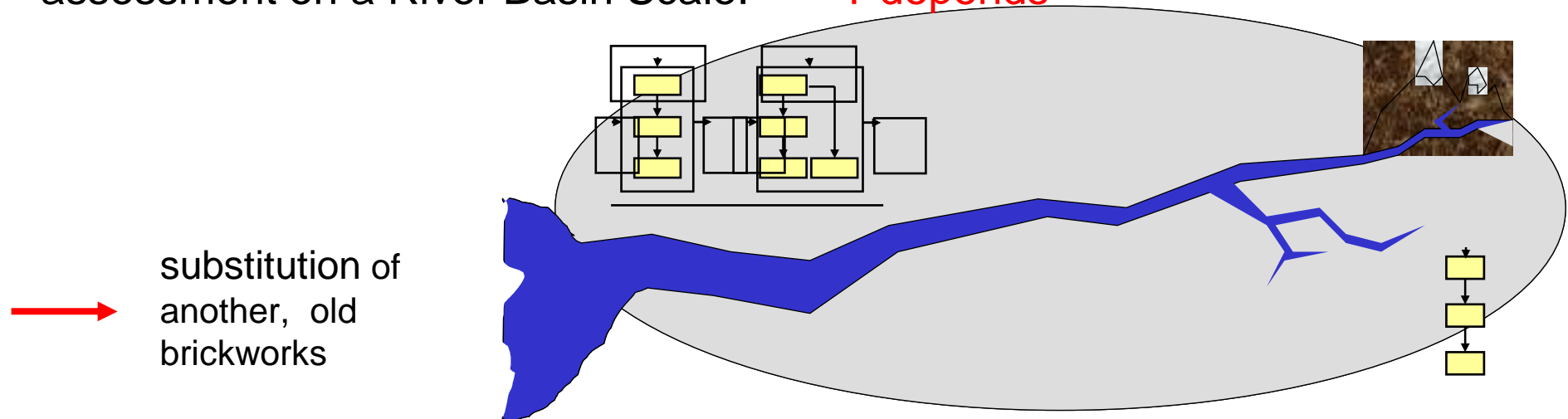
assessment on a River Basin Scale:



## 2.2 Environment: assessment on different scales

statement: brickmaking consumes more energy than disposal

assessment on a River Basin Scale: ? depends



- space consumption
- resource depletion; reuse of sediments instead use of primary resources
- climate
- mutual interactions

Arrevalo et al. 2005; Breedvelt 2001





## 2.2 Environment: assessment on river basin scale

---

Descriptive assessment based on life cycle assessment:

- t CO<sub>2</sub> more/less
- 100 ha space free for other uses
- 200.000 m<sup>3</sup>/a clay not explored
- +/- number of employees
- etc.

Problem: How to evaluate these effects?

Recommendation:

- Economic know-how to evaluate these effects on a river basin scale
- Full-cost-models, Costanza et al. 1997, *Nature*  
Farber et al. 2002, *Ecological Economics*



## 2.3 Environment: sustainability – time & space

---

“Environmental, economic and social aspects must be integrated *in a river basin view* and interventions *like dredging or disposal of sediments* should not result in unwanted impacts elsewhere or **any time** in the river basin.”

River Basin Scale

time scale?

Sed  
Net



## 2.3 Environment: sustainability – time & space

---

time scale?

sustainability related to intergenerational equity

Recommendation:

more than 30 years (1 generation) should be considered in our assessment procedures as well as in our decision-making

Sed  
Net



decision-makers are responsible for a budget, but:

- a lot of benefits are beyond the responsibility = budget of authorities
- a lot of benefits are problematic to be evaluated in terms of €

high investment solutions need long term contracts because of depreciation, seldom offered in form of a call for tender

Recommendations:

- **assessing a generation's time scale** offer the chance to calculate costs for **long term contracts**
- **research on how to evaluate and integrate environmental benefits** like saving primary resources, non-consumption of areas etc. (Costanza et al. 1997; Farber et al. 2002)



- NIMBY: Not-in-my-backyard,
- „who is willing to pay for sediment treatment or a more expensive treatment?“

Obviously: Nobody, .....

.... until he/she is informed about the consequences!

Education and information:

- school
- media
- project-specific
- others (lifelong learning and education)



**River basin scale and a sustainable time scale (30 years = one generation)!**

**assessment with a combination of tools**

(costs, LCA, risk assessment studies, communication) , because no single tool covers all fields necessary to be considered (**economy, environment, society**)

**methods should consider long-term effects** (life-cycle of sediments, products and wastes) and the **dicrepancy between biological and chemical methods**

**harmonization of assessment methods/standards** to avoid transport of sediments across borders between countries applying different standards

**integration of broader economic know-how in order to evaluate benefits beyond common budgets and to consider “hidden costs”**

**“Information and education”**

(schools: pupil & teachers; administrations: courses & workshops; researches: interdisciplinary work; project-specific information from the beginning on)



## 6. Acknowledgements

---

- EC: funding & discussion
- SedNet-homebase: organisation (San Servolo; congresses; internet; publication in JSS) and hospitality
- all colleagues of WP4: co-operation, real networking, future projects
- Prof. Glasby: discussions considering sustainability
- Colleagues at University of Bremen: co-workers in many projects; discussion, critics



Sed  
Net





extra



Goal

# Decision-making: best available technique

Options

A B C

Criteria

**Economic**

**Environmental**

**Social**

Sub-criteria  
tools

Costs, budget  
Benefits  
Development  
Infrastructure  
market

LCA-based  
Bioassays, risk  
assessment

Acceptance  
Employment  
education

Depletion of  
resources

Global  
warming

Land  
demand

Eco-toxicity

Global

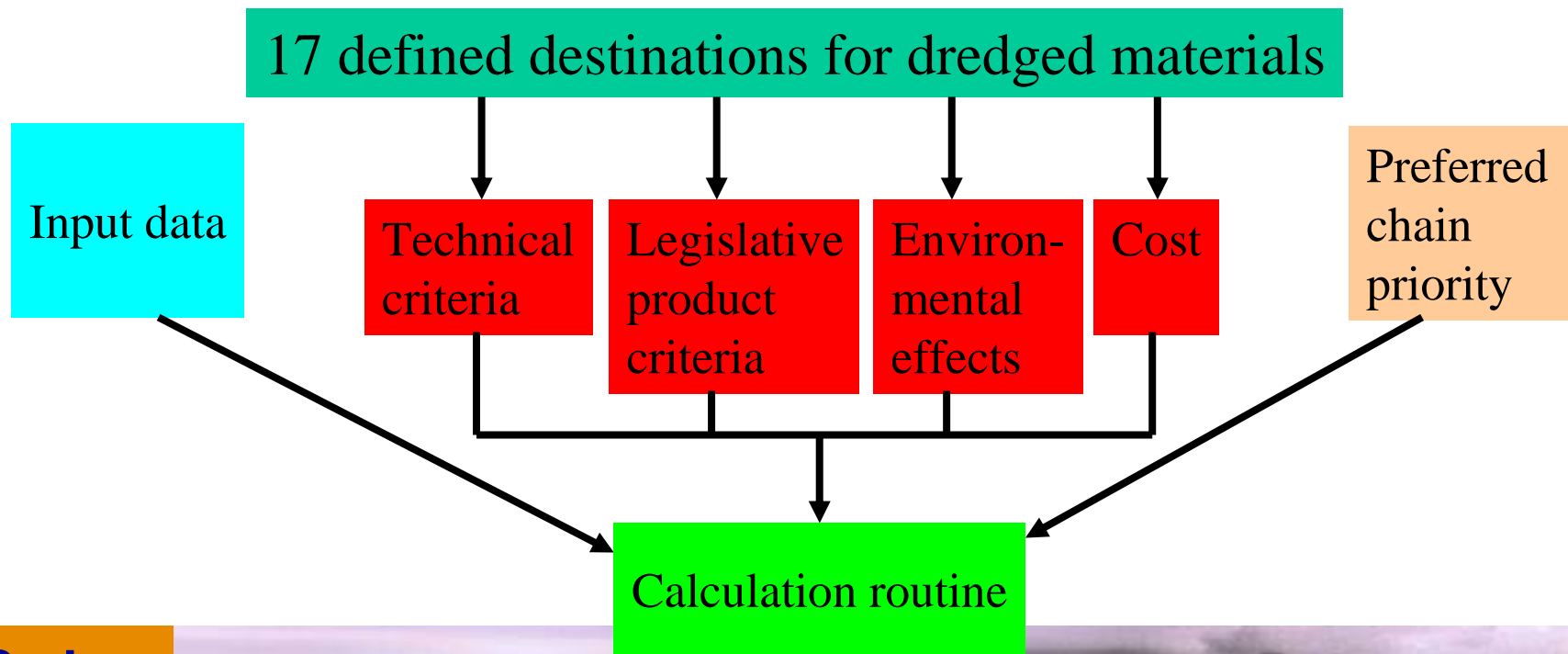
Regional / local



## 2. Criteria Environmental aspects, continued

“Un-contables”: climate, resource consumption, space demand

### Prospect



## 2. Criteria Environmental aspects, continued

“Un-contables”: climate, resource consumption, space demand

### Prospect

