

# ECOLOGIC CONSTRUCTION MATERIALS - OVERVIEW AND INTRODUCTION TO THE TOPIC -

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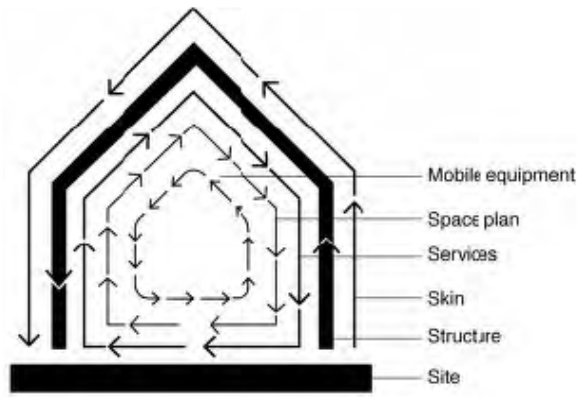
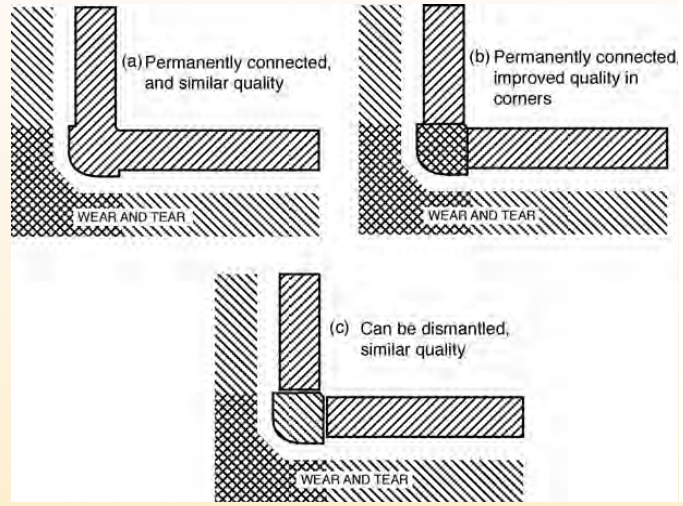
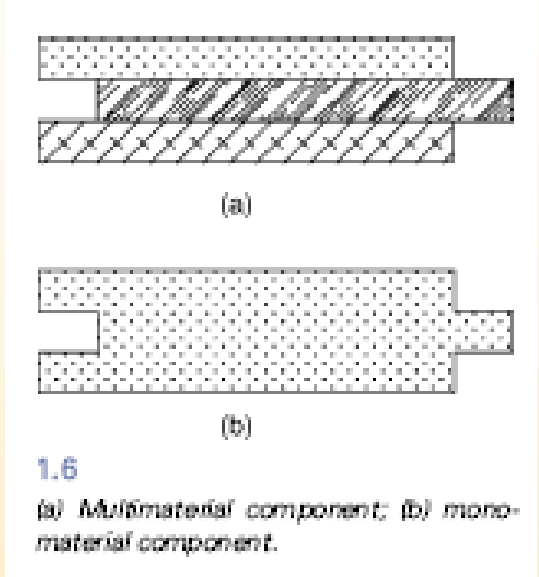
1. Before starting to build
2. Ecologic concerns of materials
3. Ecology during the building cycle
4. Stakeholders



# 1 Basic philosophy on ecologic constructions

- Ecologic construction means to think about structures first!
  - Salvageability
  - Wood protection by construction
  - Durability
  - Energy consumption

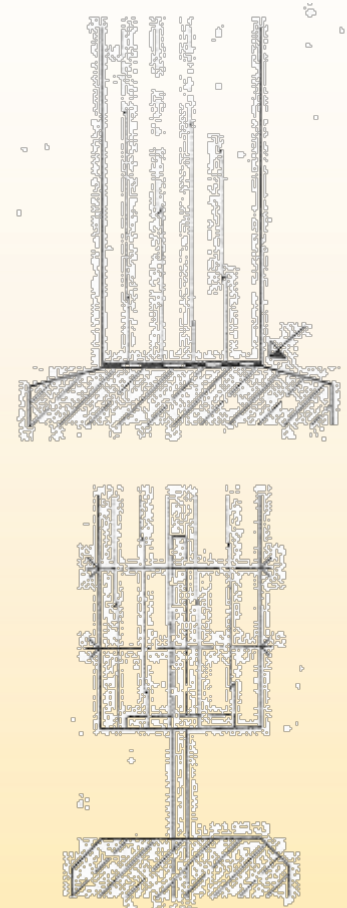
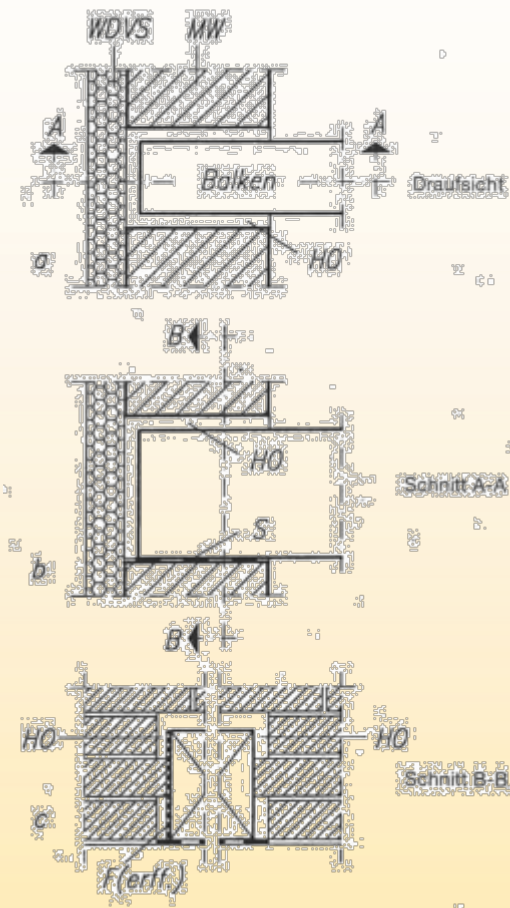
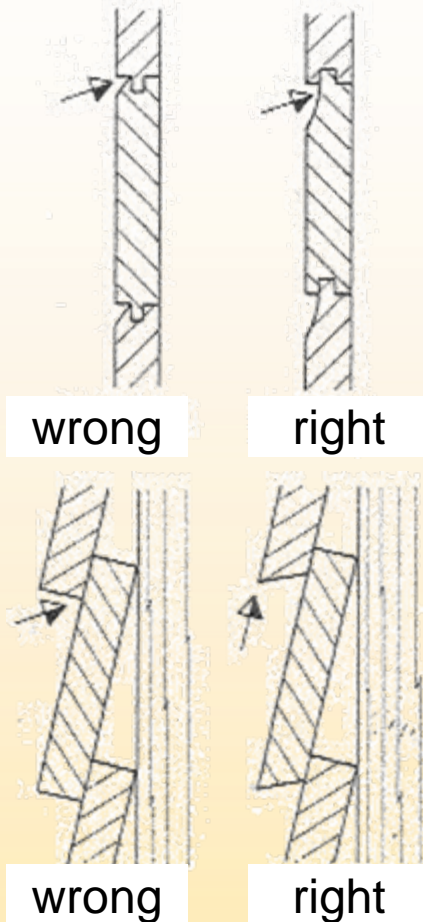
# Salvageability



**SHEARING LAYERS OF CHANGE.** Because of the different rates of change of its components, a building is always tearing itself apart.

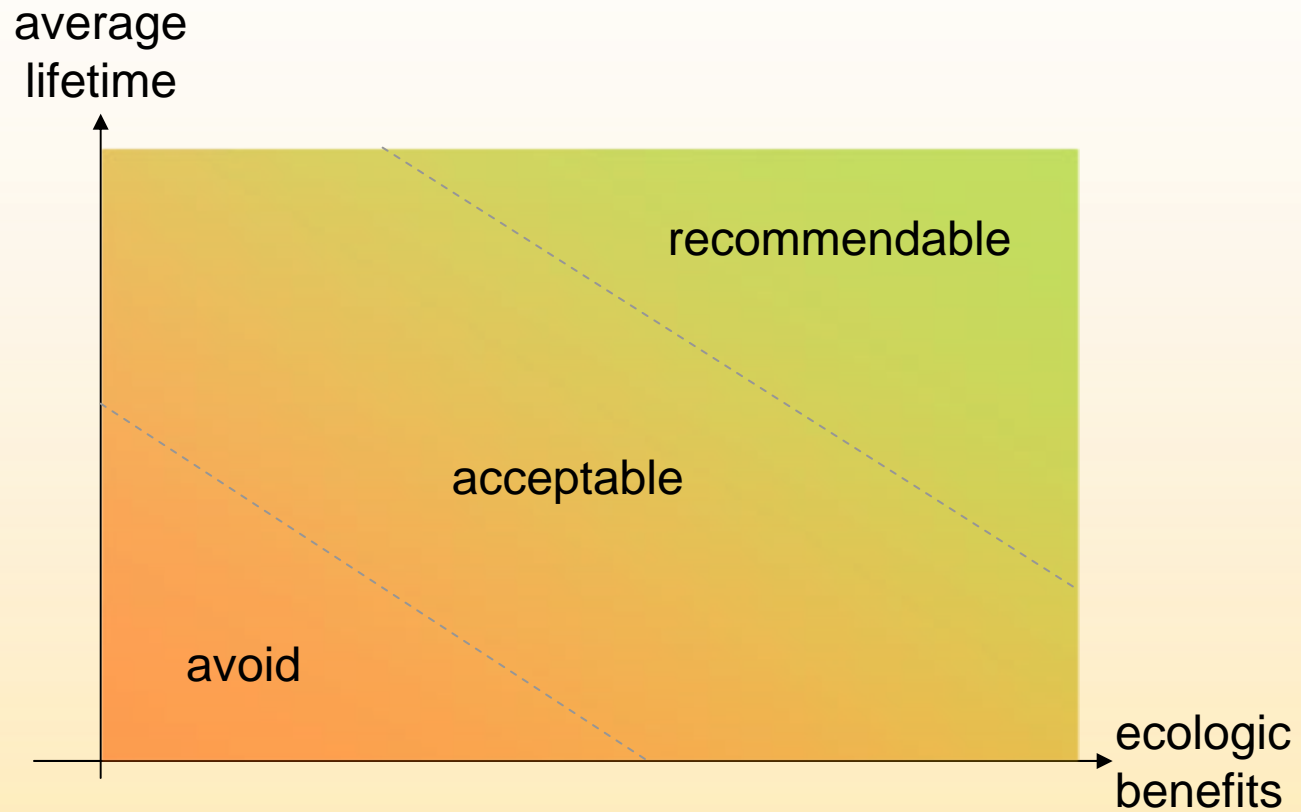
# Wood protection by construction

Can save chemical treatment!



<http://www.umweltschutz-bw.de/?lvl=2978>

# Durability



## 2

# Ecologically sustainable construction

- Reducing the impact on our natural environment and using resources in a sustainable manner → reducing the...
  - ... Impact on natural and cultural landscapes
  - ... Impact on soil, flora, fauna, local climate
  - ... Emissions of climate-relevant gases
  - ... Emissions of other pollutants (SO<sub>x</sub>, NO<sub>x</sub>)
  - ... Burden caused by disposing or recycling waste

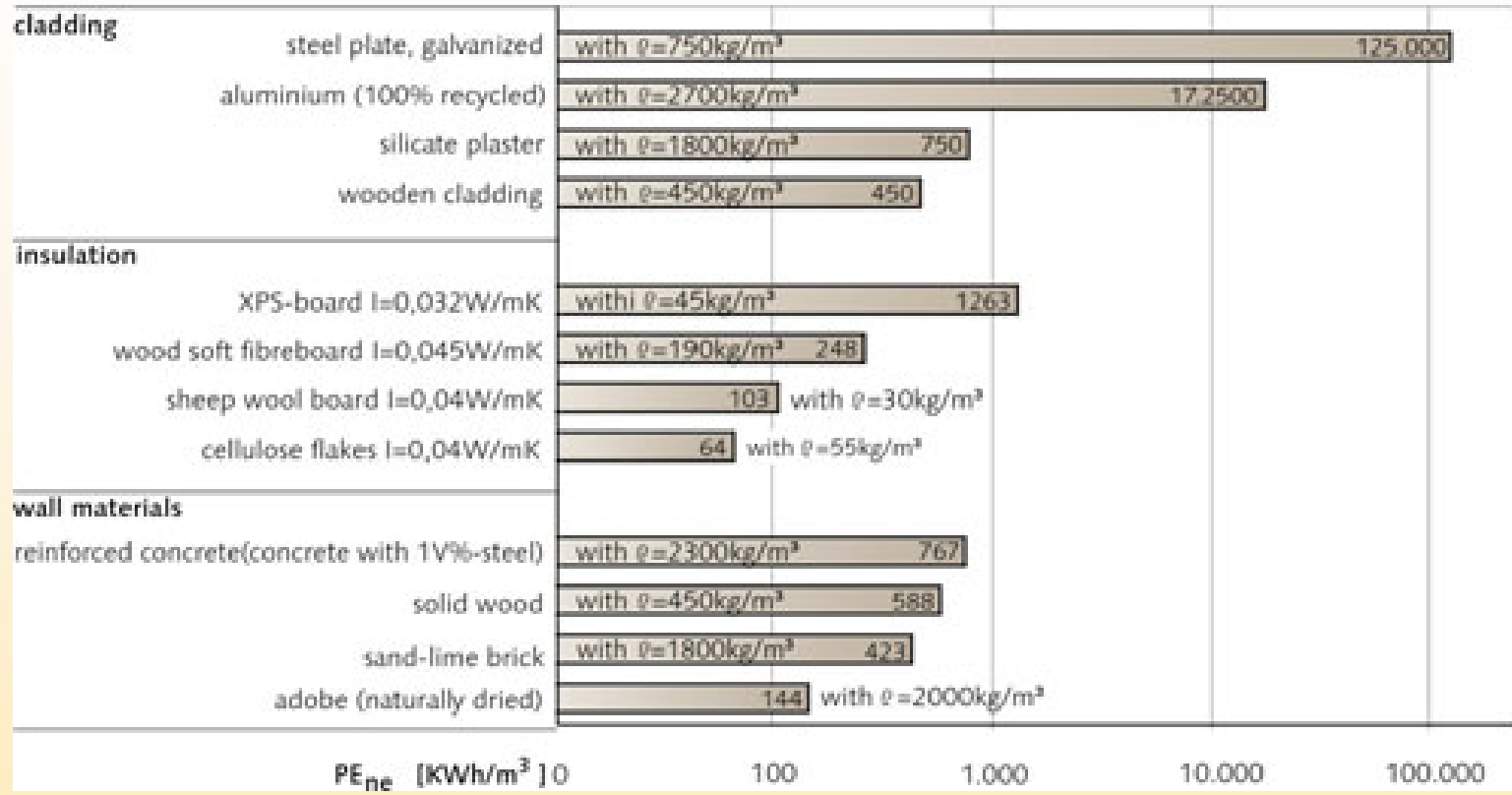
# Ecologic aspects (impacts)

- Embodied energy
- Emissions (greenhouse gases, NOx, VOCs) during extraction, production, processing, use and recycling leading to different environmental problems
- Sustainability of production and extraction and the limitation of raw materials
- Land use and land degradation
  - Burden caused by disposing
- Impact on human health

# Ecologic aspects: Embodied energy

- Units: kJ or MJ per kg or m<sup>3</sup>
- Borders of analysis:
  - **Cradle to gate** (until the product leaves the factory)
  - Cradle to site (including transport, packaging)
  - Cradle to grave (life cycle assessment)
  - Cradle to cradle (including analysis recycling or reusing – or energy gaining from burning)
- Limits of calculation
  - Canteens for employees? Night guard of the factory?
  - Costs for road maintenance?

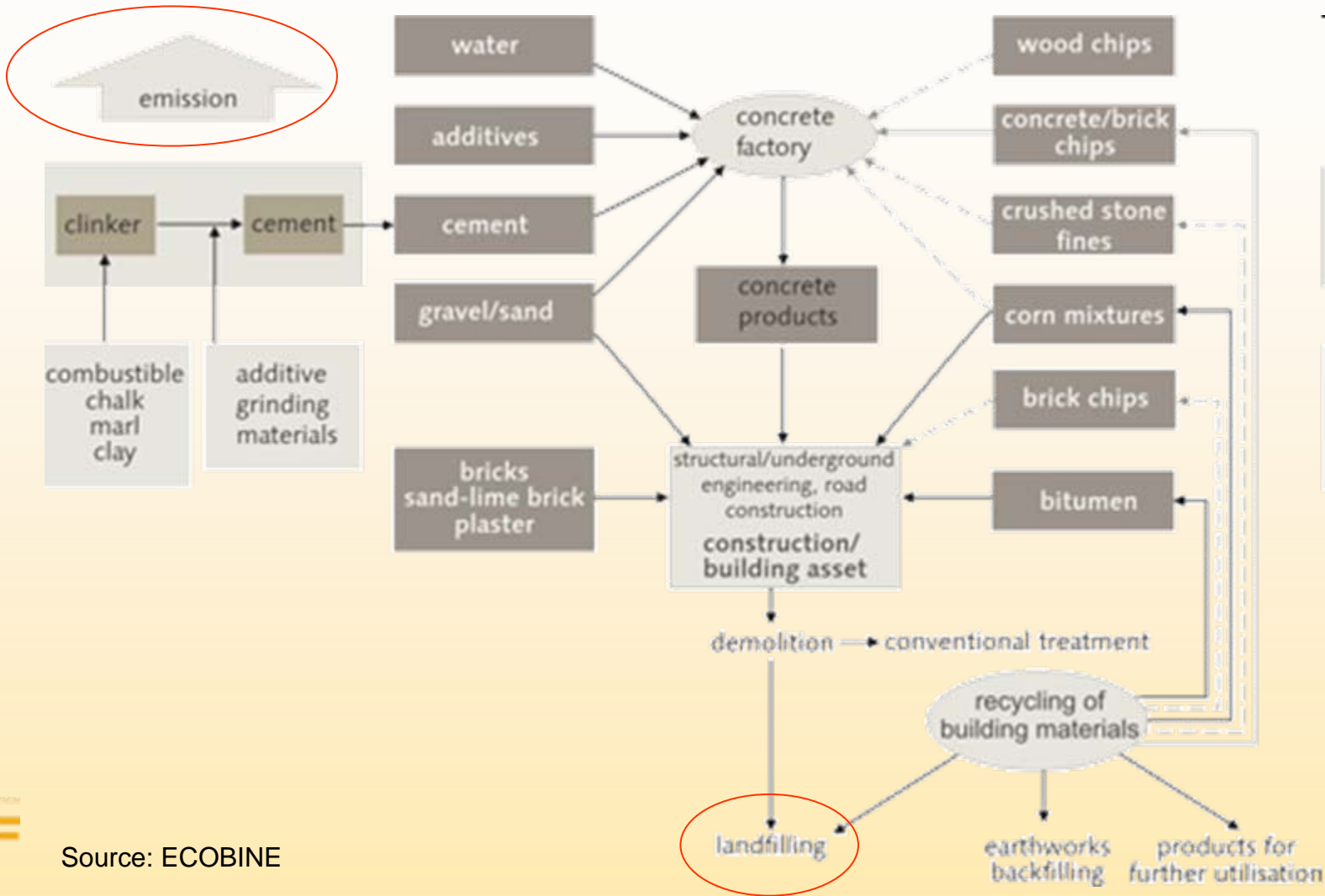
# Embodied energy



Primary energy input (non renewable, cradle to gate), source: ECOBINE, Based on data from IBO



# Ecologic aspects: example concrete



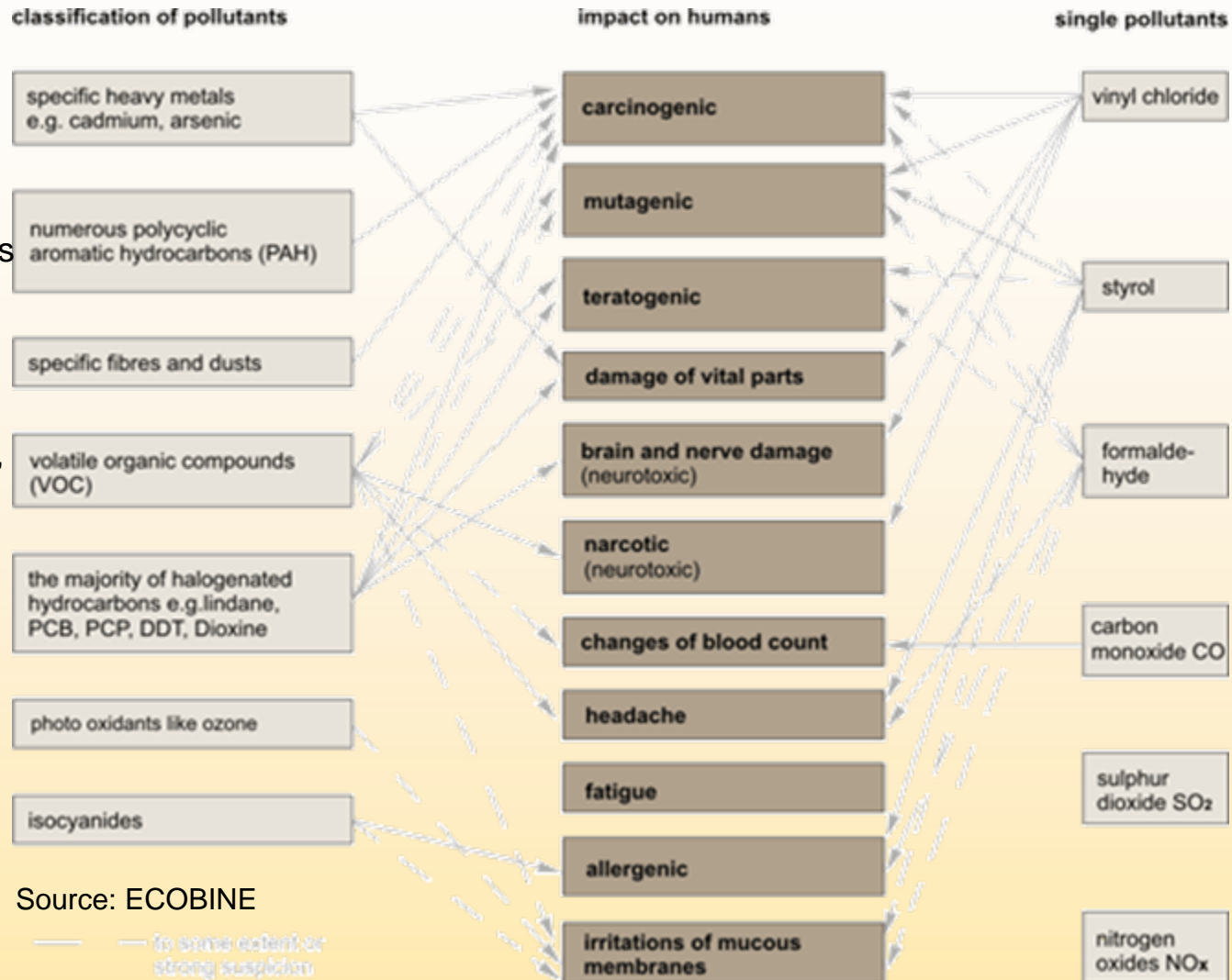
Source: ECOBINE

# Ecology and health

- Health aspects in construction
  - Indoor humidity
  - VOCs
  - Thermal comfort
  - Air tightness, „drafts“
  - Dust



# Pollutants and impact on humans



# Ecology and health – paints

<i>Pigment</i>	<i>Constituents</i>	<i>Comments</i>
White pigments:		
Chalk	Calcium carbonate	From natural resources; not very strong in oil paint
Glass white	Ground, recycled glass	At an experimental stage
Lead white	Lead carbonate or lead chromate	Highly toxic; also used as siccativ
Titanium white	Titanium oxide	Most widely used white pigment
Zinc white	Zinc oxide	Toxic; fungicidal effect; usually produced from recycled zinc
Red pigments:		
Cadmium red	Cadmium selenide	Highly toxic
Chrome red	Lead chromate	Highly toxic
Iron oxide	Ferrous oxide (Fe II)	Originally an earth pigment
Red lead	Lead tetroxide	Highly toxic, antcorrosive
Red ochre	Hydrated ferric oxide (Fe III)	Originally an earth pigment

Berge, B. (2009): The Ecology of Building Materials: 390

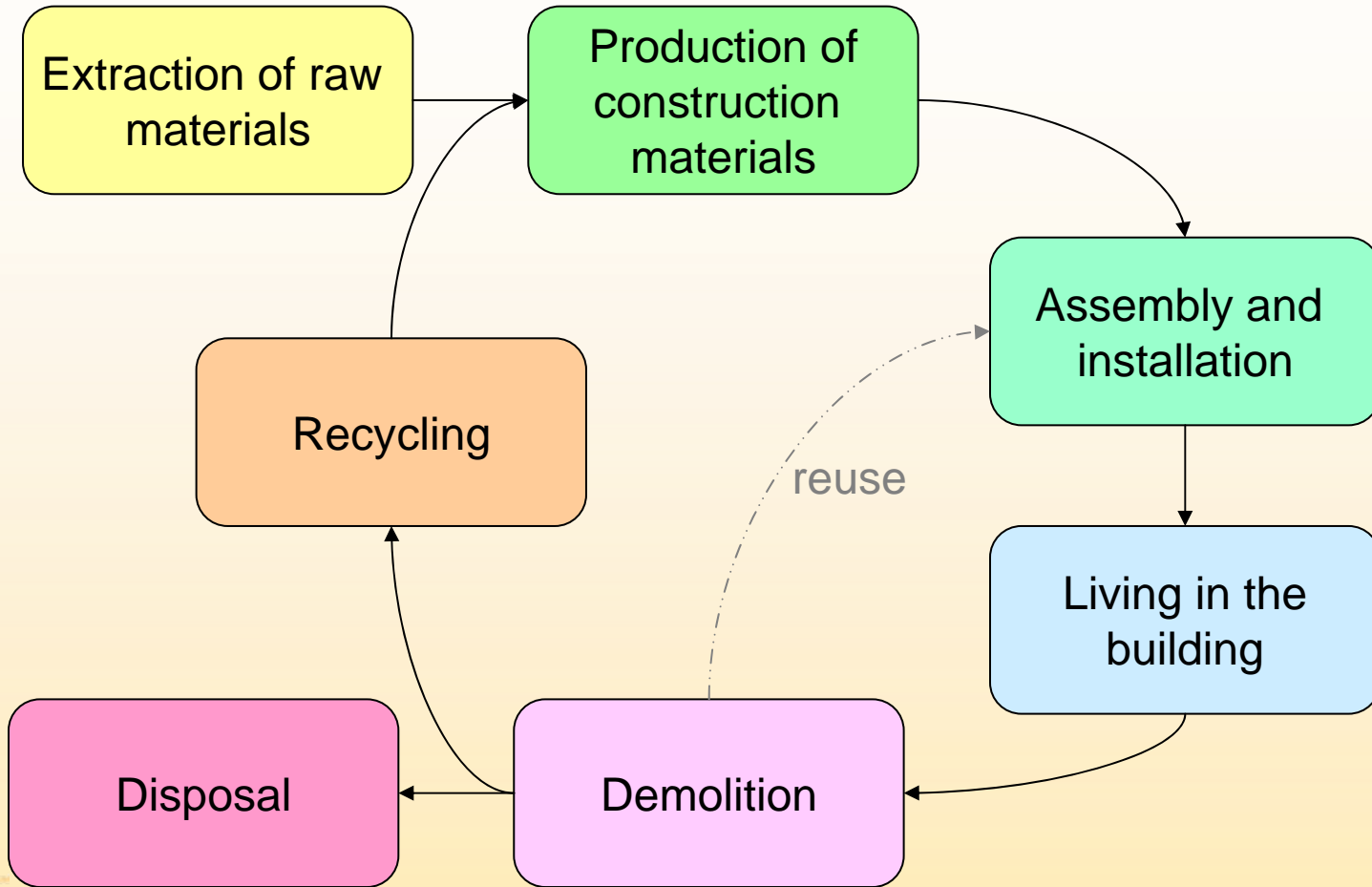
# Limitation of resources

<i>Raw material</i>		<i>Reserve [years]</i>	<i>Reserve base [years]</i>	<i>Annual growth in consumption 1999–2006 [%]</i>
MINERAL				
FOSSIL				
40	Coal	150		4.5
41	Natural gas	63		3
42	Crude oil	41		1.4
5	Boric salts	35	86	1
6	Brom	Large	Large	
7	Cadmium	26	77	1
8	Chrome	Ca. 25	Ca. 40	8
9	Clay, for fired products	Very Large	Very Large	
10	Cobalt	121	226	15
11	Copper	31	61	3

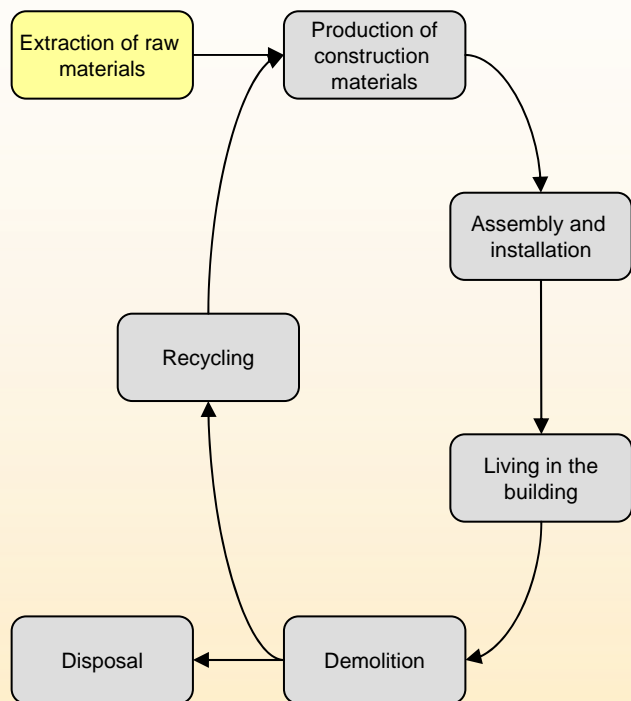


Berge, B. (2009): The Ecology of Building Materials: 4-5

# The building cycle



# Extraction of raw materials



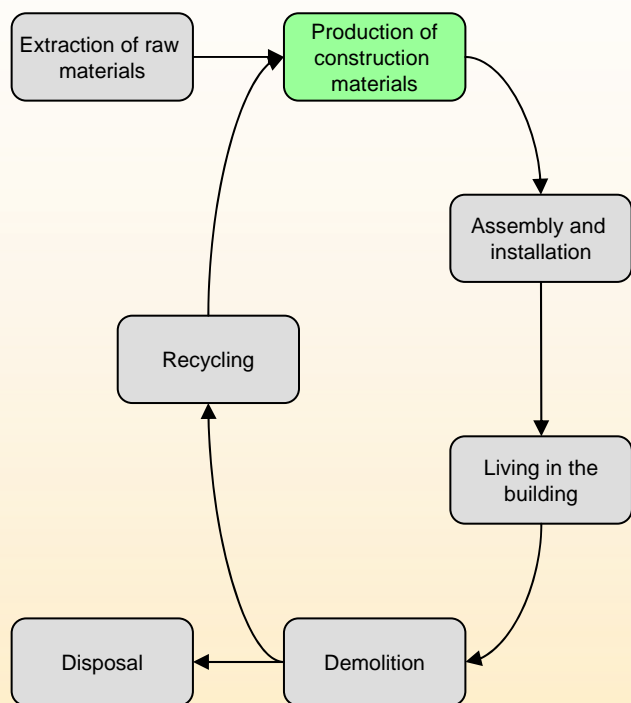
## Aspects to consider

- Using limited resources
- Emissions and waste
- Impact on landscapes
- (Social conditions)

## Options

- Using renewable resources
- Using resources from certified sources (FSC)
- Local availability of resources

# Production of materials



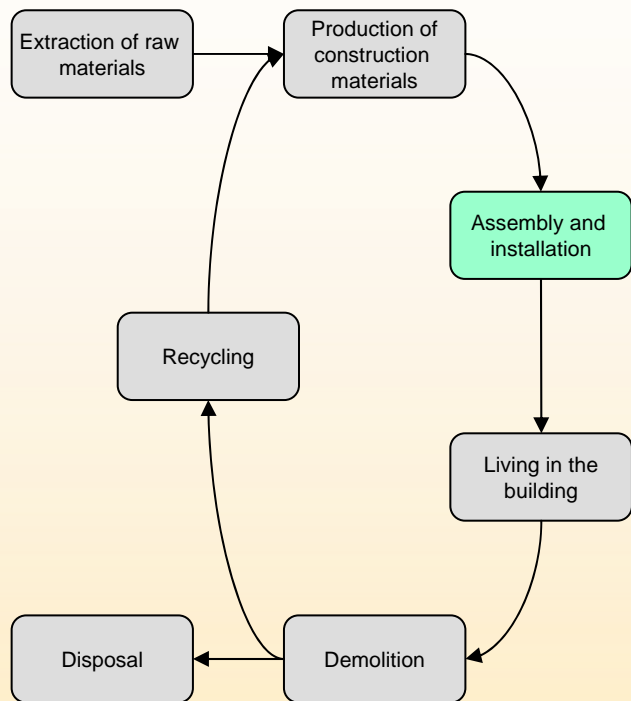
## Aspects to consider

- Aggressive chemicals and the emissions during production (e.g. acids for  $\text{TiO}_2$  or isocyanides for PUR)
- Waste and emissions
- Energy demand
- Packaging and transport
- Production costs

## Options

- Substitution of products and process chemicals if possible (e.g. yellow pigment  $\text{PbCrO}_4 \rightarrow \text{BiVO}_4$ )
- Using renewable energy resources and recycling materials or waste products

# Assembly and installation



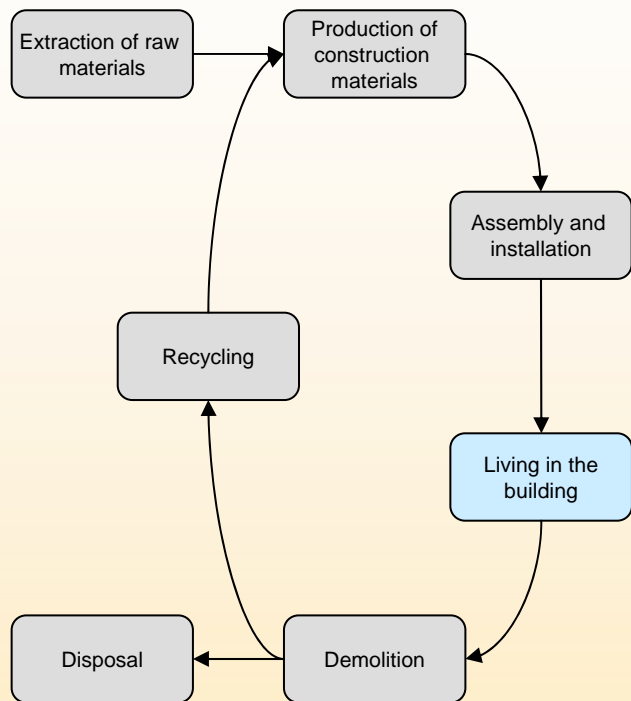
## Aspects to consider

- Waste from packaging and installations (cut-offs etc)
- Emissions from unpacked materials (VOCs)
- Structural aspects of the building
- Costs

## Options

- Low emission products
- Minimize packaging or use packaging which can be reused
- Using custom-fit parts

# Living in the building



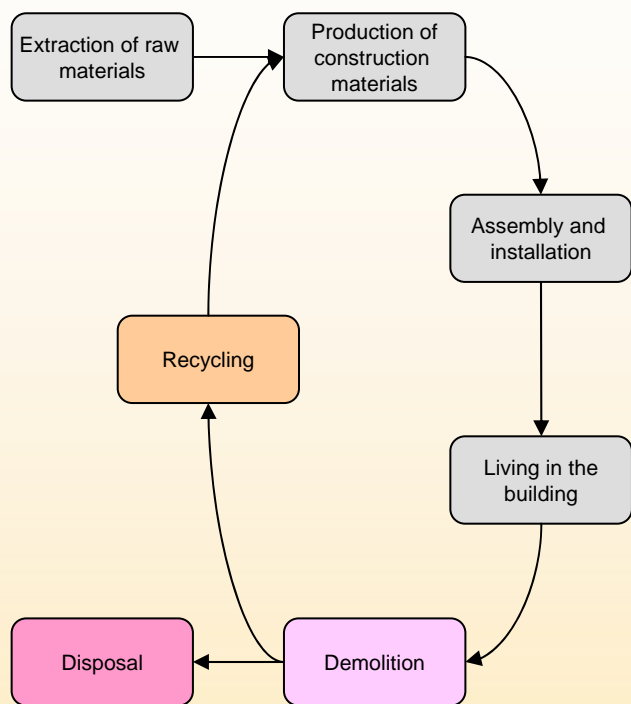
## Aspects to consider

- Improper maintenance and hygiene
- Energy consumption
- life time (durability: shrinkage, embrittlement, oxidation)
- Case of damage (fire)
- Maintenance and replacement costs
- Indoor climate
  - Emission of VOCs and odors
  - Humidity

## Options

- Low-emission products
- Products with a preferably long life time
- Products that influence the indoor climate positively

# Demolition, recycling and disposal



## Aspects to consider

- Disassemblment (separability)
- Waste
- Transport needs
- Pollutants (e.g. asbestos)
- Energy generation from waste
- Costs for recycling

## Options

- Think about separability already in the design phase
- Use products that have can be recycled or at least downcycled or economically burned

# Actors and stakeholders

## Direct market actors

- Producers
- Retailers
- Architects and engineers

## Indirect influence

- Public administrations (procurement)
- Public funds (subsidies, support programmes)
- Research facilities
- Associations of producers
- Customer advice councils
- Interest groups and NGOs

# Problem „customer“

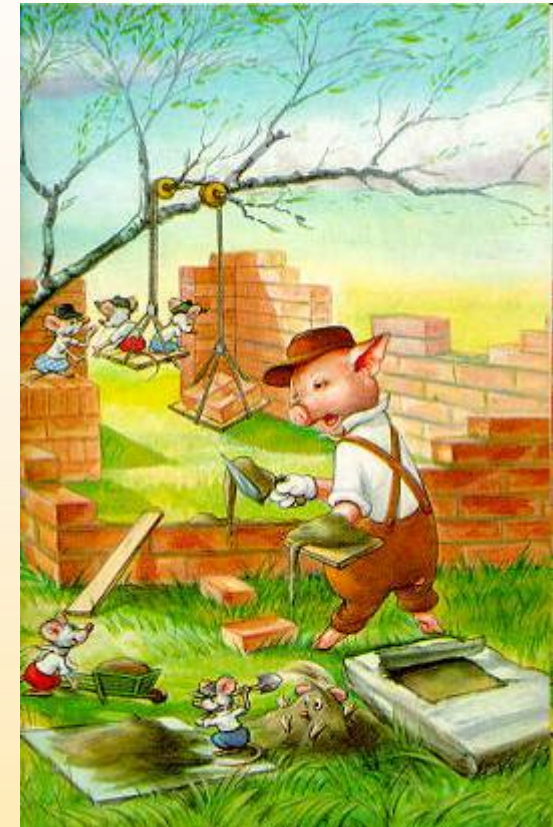
Straw house



Timber house



Brick house



# Problem „customer“

- Idea of a building (solid and everlasting) → eco materials are not considered as fulfilling these criteria
- Eco materials do not come to mind
- Customers are not informed and aware of the variety of alternatives
- Materials are considered expensive (and in many cases they actually are!)

# Confusing variety....



# Motivation to use ecologic materials

- Health awareness (VOC-free flooring and insulation, colours and paints)
- Comfort and feeling (wood vs. metal)
- Allergies (avoidance of carpets)
- Being „trendy“ or exquisite (wood floors)
- Altruistic motives (“being green”)
- Price?
  
- Others?

# Thanks!

Recommended links:

- <http://www.ecobine.de/index.php?l=en>
- <http://wecobis.iai.fzk.de/cms/content/site/wecobis/Home> (only in German)