

Ecomaterials - aspects for consideration

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7 December 2010

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Ecological construction materials

No common definition and criteria to follow, thus:

different understanding / interpretation

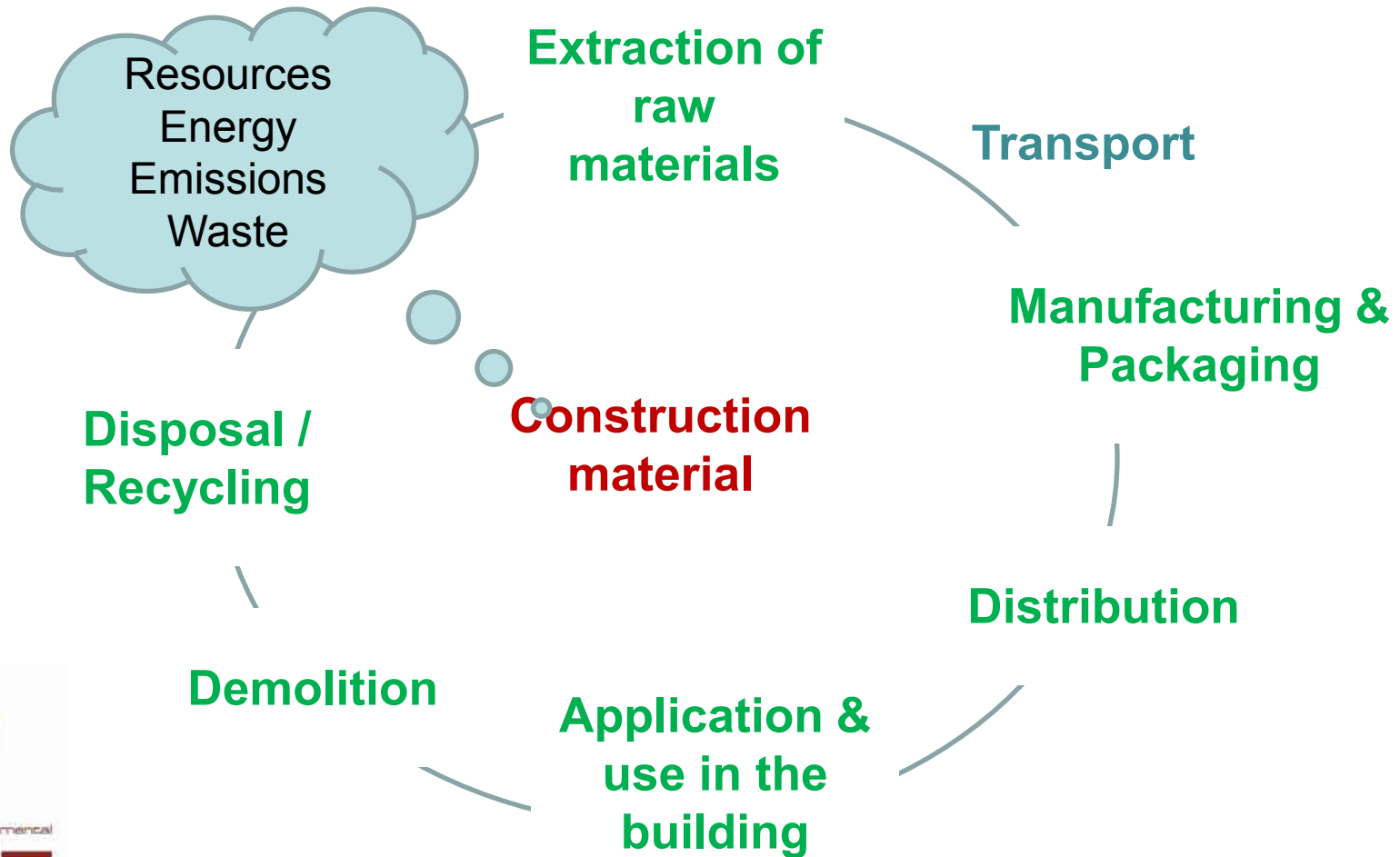


Examples of definitions:

- **Eco-materials** are those that can contribute to reduction of environmental burden through their life cycles” (Shinohara, 2004)
- **Environmentally preferable products** - those having a lesser or reduced effect on human health and the environment when compared with competing products that serve the same purpose (US EPA)
- **An ecological building material/product** is a material/product with no heavy negative environmental impact and with no negative health impact”
(Interreg IVB project CAPEM, 2010)

**Various aspects / criteria to be considered / analysed / compared
in a holistic way before selection of a material !**

Environmental considerations in building cycle



Evaluating building materials

- **Energy** - embodied energy, energy sources
- **Pollution and waste** – polluting substances from production, transportation, application/use, disposal
- **Local product** – local resource (overlooked/ underused)
- **Reuse and recycle** – post-consumer (preferable) / post-industrial
- **Durability** – required maintenance over life time
- **Compatibility** – performance of system function, other materials

Environmental aspects: Embodied energy

- Units: kJ or MJ / kg or m² or m³
- 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 - example

Embodied energy and CO₂ released in the production of windows

| Material | (MJ/m ²) | kg CO ₂ /m ² |
|--|----------------------|------------------------------------|
| Aluminium 2x glazed, argon filled, window | 5470 | 279 |
| PVC 2x glazed, argon filled, window | 2310 | 118 |
| Aluminium clad timber, 2x glazed, argon filled, window | 1200 | 61 |
| Timber 2x glazed, argon filled, window | 360 | 18 |

Source: GreenSpec, UK

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 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

Choosing local product

- Uses local sources
- Reduces transportation – energy, CO2 emissions, costs, delays
- Strengthens local economy, ensures working places
- Customer benefits from local knowledge, experience

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

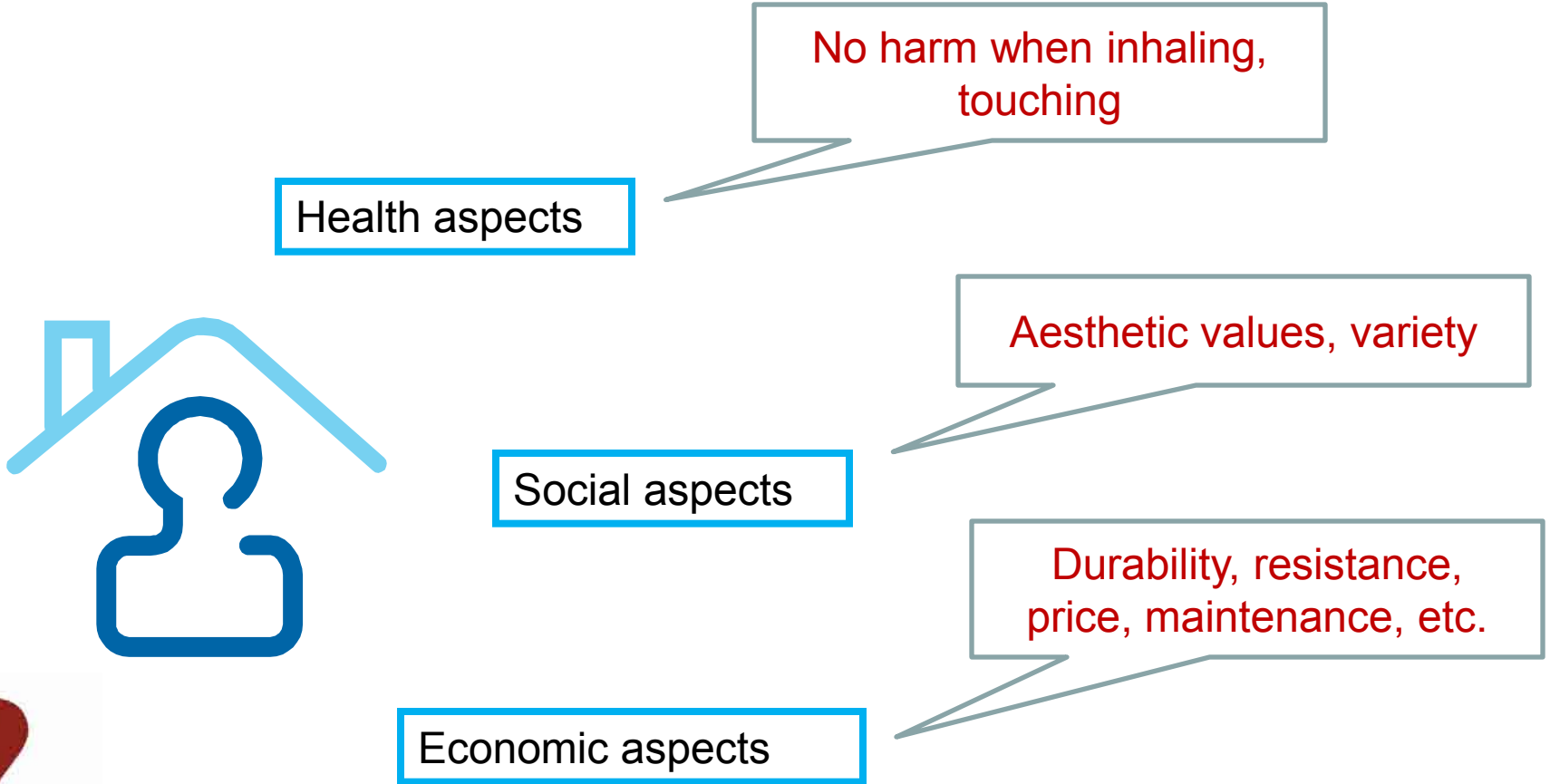
Living in the building

- 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

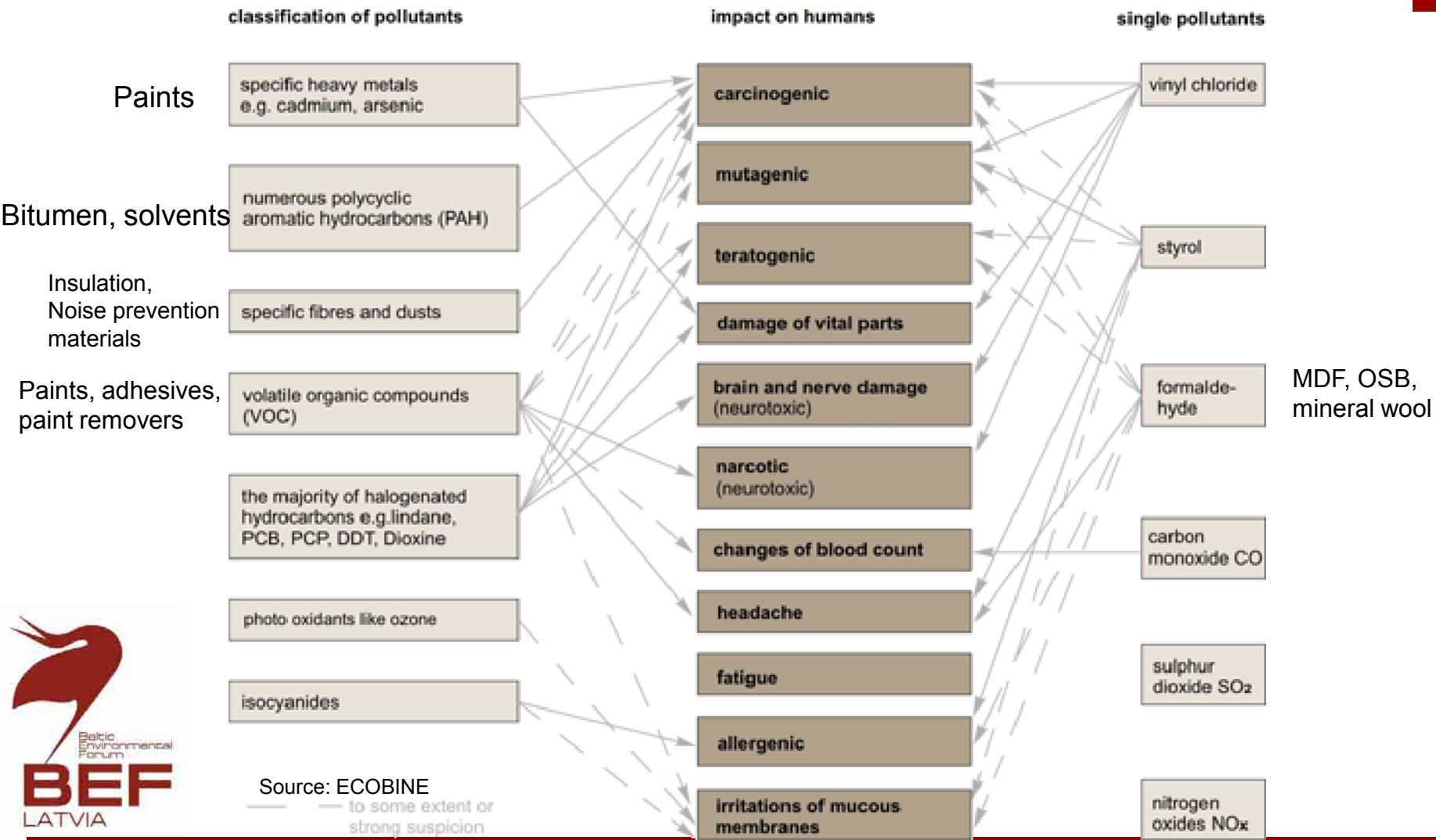
Demolition, recycling and disposal

- 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

When it comes to the consumer



Pollutants and impact on humans



MDF, OSB, mineral wool



Health aspects - paints

| Pigment | Constituents | Comments |
|-----------------|---------------------------------|---|
| 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, anticorrosive |
| Red ochre | Hydrated ferric oxide (Fe III) | Originally an earth pigment |

Motivation to look for ecological 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?

Confusing variety...



Instructions for purchasing materials – Düsseldorf, DE

| Black list | Dark grey list | Grey list | Light grey list | White list |
|--|---|--|--|--|
| Existing bans for using the materials; renovation might be necessary | To be avoided for new purchases; special disposal for old materials | Problems are existing, case-based decision | Limited problems, partly only suspected | Unproblematic |
| <ul style="list-style-type: none"> •Asbestos •PCB •PCP •CFCs | <ul style="list-style-type: none"> •PVC •H-CFC •Cadmium containing substances •Substances with high shares of (halogenated) solvents, plasticizer or formaldehyde •Tar •Wood from primary forests | <ul style="list-style-type: none"> •Artificial mineral fibres •Polyurethane •Colours, paints •Coatings, glues, bitumen •Several metals: aluminium, zinc, lead, chrome, copper | <ul style="list-style-type: none"> •Polystyrene and Polyamide •Styrene-butadiene-rubber •ABS (?) •Linoleum, other materials from renewables, depending on additives (e.g. recycled paper) •Iron, steel •Concrete, mortar, plaster •Cement | <ul style="list-style-type: none"> •Polyethylene •Polypropylene •Mineral construction materials (tiles, bricks etc.) •Wood from certified ecologic forestry – depending on treatment |

Problem „customer“

- Eco materials do not come to mind
- Customers are not informed and aware of the variety of alternatives
- Price is determining the choice
- Idea of a building (solid and everlasting) → eco materials are not considered as fulfilling these criteria
- Many myth

Thanks for attention!

Useful links:

- Information about green building products, materials, construction techniques, UK
www.greenspec.co.uk/html/materials/embodied_energy.html
- Eco-friendly construction, UK
www.sustainablebuild.co.uk/EcoFriendlyConstruction.html
- Instructions for purchasing materials in Düsseldorf, Germany
www.duesseldorf.de/umweltamt/download/bauen/baustoffe.pdf
- Building materials in a green economy, Canada
www.greeneconomics.net/BuildMatEssay.html

