Figures: METLA/Jussi Tiainen

http://www.metla.fi/tiedotteet/2005/2005-02-07-metla-ta
vihkijaiset.htm

Building sustainable
METLA case

Tarja Häkkinen

Building Sustainable

- Assessment of environmental impacts (standards and methods)
- METLA-case
- Tools for environmental assessment (BECOST)
- Service life design
- Tools for service life estimation of wooden products - ENNUS WOOD

LIFE CYCLE ASSESSMENT OF ENVIRONMENTAL IMPACTS - LCA

- ISO 14040:
- compilation and evaluation of the inputs, outputs and the potential environmental impacts of a product system throughout its life cycle
- LCA is a technique for assessing the environmental aspects and potential impacts associated with a product, by
- compiling an inventory of relevant inputs and outputs of a product system;
- evaluating the potential environmental impacts associated with those inputs and outputs;
- interpreting the results of the inventory analysis and impact assessment phases in relation to the objectives of the study. An inventory may include environmental aspects which are not directly related to the inputs and outputs of the system.

LIFE CYCLE INVENTORY ANALYSES

- LCI
- ISO 14040
- phase of life cycle assessment involving the compilation and quantification of inputs and outputs, for a given product system throughout its life cycle

FINNISH EKA METHOD FOR ENVIRONMENTAL DECLARATIONS OF BUILDING PRODUCTS

- The methodology gives guideline for formulating the eco-profiles of the building products and assessment of environmental impacts of the building during its life cycle.
- An eco-profile expresses the environmental impacts of the building product on the basis of the results from the life cycle inventory (LCI). The results cover all stages 'from the cradle to a factory gate'. Energy resource consumption during the use phase is excluded.
- The environmental declarations also include the following environmental aspects of the building products:
  - transport of the products and environmental pressures from the construction site,
  - effects on the quality of indoor air,
  - service life and need for care and maintenance, and
  - recycling and final disposal.

METLA CASE

- METLA - Finnish Forest Research Institute (www.metla.fi)
- New office building in Joensuu, 2004
  - floor area 7 670 m^2
  - building volume 33 300 m^3
  - living area 6466 m^2
- Designers
  - Architect office SARC
  - Engineering design office Magnus Malmberg
  - HVAC design office Olof Granlund
- Senate Properties
- Sea photos in:
- www.cdqsolutions.com/woodfocus/puupalkinto/arkkitehdinesitys.pdf

METLA Case - Design Requirements

Senate Properties' ways of working include that sustainability issues are dealt with integrated with the whole process.

METLA project aimed at minimising environmental impacts with help of

- appropriate space solution,
- quality of indoor conditions,
- considering environmental aspects in the selection of products and technical solutions.

Senate Properties stated the following life-cycle objectives for the project:

- service life,
- energy consumption,
- performance: indoor conditionts, flexibility, usability,
- use and maintenance costs.

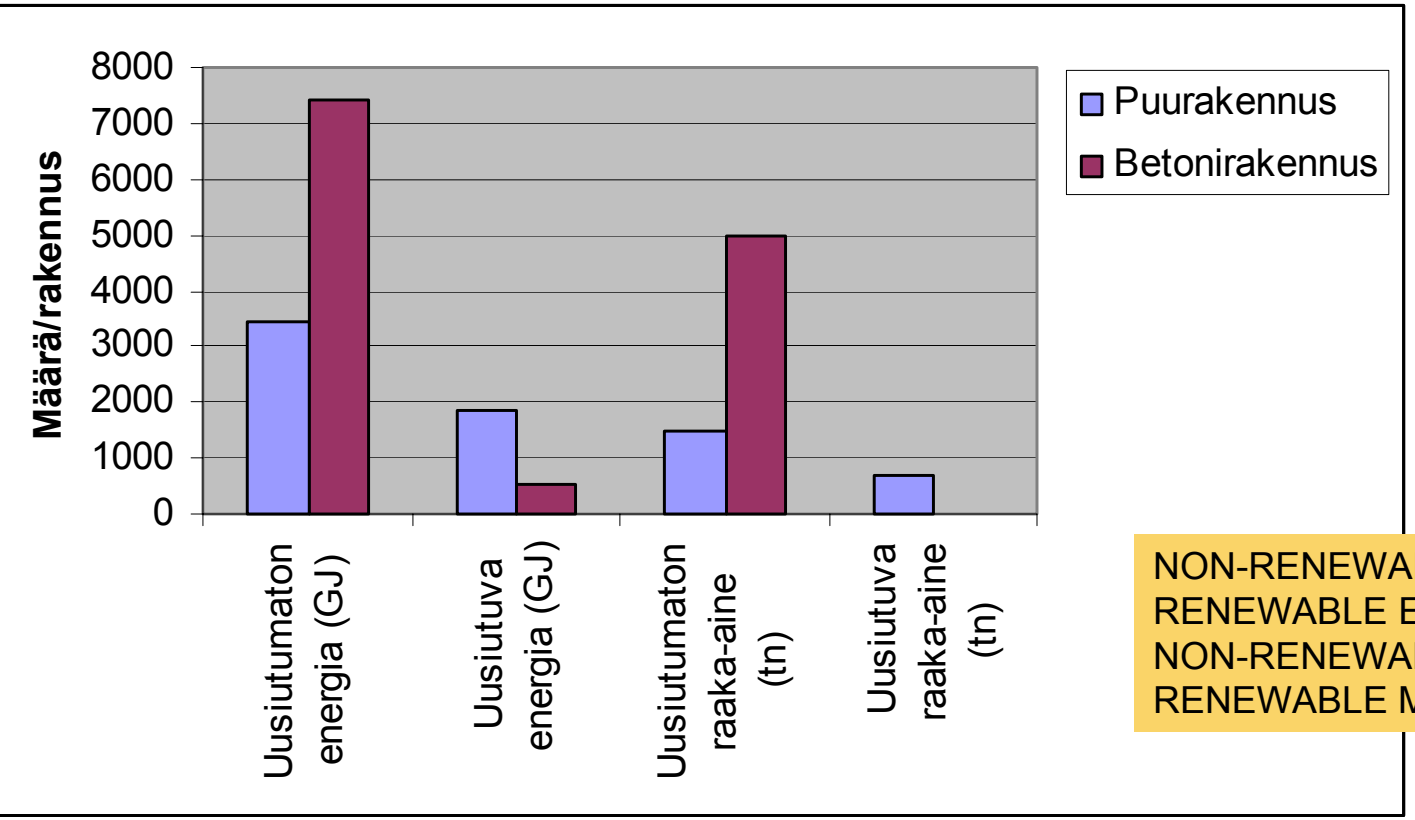
PromisE YMPÄRISTÖLUOKITUS

ASSESSMENT OF METLA BUILDING

- The assessment was done according to the EKA principles.
- Wooden structures were compared to corresponding concrete structures (designed by MM).
- The alternative structures were comparable in terms of structural capacity and thermal performance (U-values), (FU).
- The study covered the structural parts of the building while other building parts were excluded.
    - The exclusion was justified because the choice of structural components did not essentially affect the quality and quantity of other products.

RESULTS / METLA

RESOURCES:

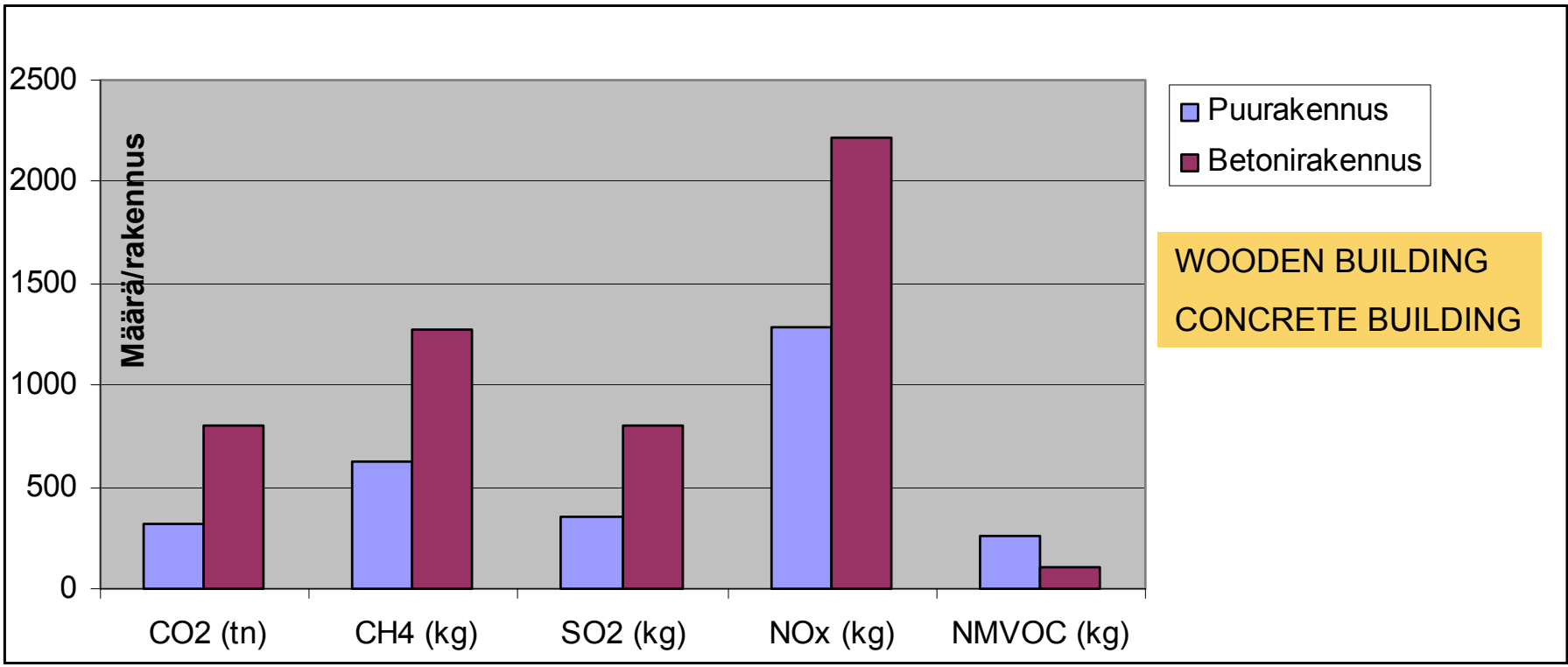


WOODEN BUILDING

CONCRETE BUILDING

NON-RENEWABLE ENERGY (GJ)
RENEWABLE ENERGY (GJ)
NON-RENEWABLE MATERIALS (TN)
RENEWABLE MATERIALS (TN)

EMISSIONS:


2500
2000
1500
1000
500
0
Määrä/rakennus
CO2 (tn)
CH4 (kg)
SO2 (kg)
NOx (kg)
NMVOC (kg)
Puurakennus
Betonirakennus
WOODEN BUILDING
CONCRETE BUILDING

ANALYSES OF RESULTS

	WOODEN BUILDING	CONCRETE BUILDING
NON-RENEWABLE ENERGY (GJ)	3 500	7 400
RENEWABLE ENERGY (GJ)	1 900	540
NON-RENEWABLE MATERIALS (tn)	1 500	5 000
RENEWABLE MATERIALS (tn)	680	0,73

	WOODEN BUILDING	CONCRETE BUILDING
CO_2 (tn)	320	800
CH_4 (kg)	630	1300
SO_2 (kg)	350	800
NO_x (kg)	1300	2200
NMVOC (kg)	260	100

ANALYSES OF RESULTS
Effect of component weight:

	LOAD BEARING STRUCTURES, EXTERIOR WALLS AND ROOF	
	CONCRETE BUILDING	WOODEN BUILDING
Total weight (tn)	4 700	1 900
Weight of wooden structures (tn)	0	610
Weight of other structures (tn)	4 700	1 300
Share of wooden structures weight	0 %	32 %

ANALYSES OF RESULTS
Effect of component specific environmental profiles:

	Hollow core slab	Sawn timber
Nonrenewable energy (MJ/kg)	1.2	1.4
Nonrenewable raw materils (kg/kg)	1.1	0.047
CO_2 (g/kg)	140	65

SUMMARY - METLA CASE

- **Focus and limitations**
- The study focused on the production and procurement of building products and the building.
- The study did not consider the effects of assembling, in-situ construction, care and maintenance and demolition on the material flows and relative environmental impacts.
- The study dealt with the physical building, and did not consider the environmental impacts from the use of the building.

- **Results**
- The environmental impacts caused by the wooden structures of the METLA office building are significantly smaller than those of the corresponding concrete structures.
- For example
  - the assessed total release of CO2 emissions:
  - for the wooden building 320 000 kg
  - for the reference building 800 000 kg.
- The result can be explained on the basis of the low weight of the wooden structures compared to the weight of corresponding concrete structures:
  - the total weight of the structural parts (building skeleton and envelope) of the METLA building roughly 2000 tons
  - the total weight of the corresponding concrete structures nearly 5000 tons.

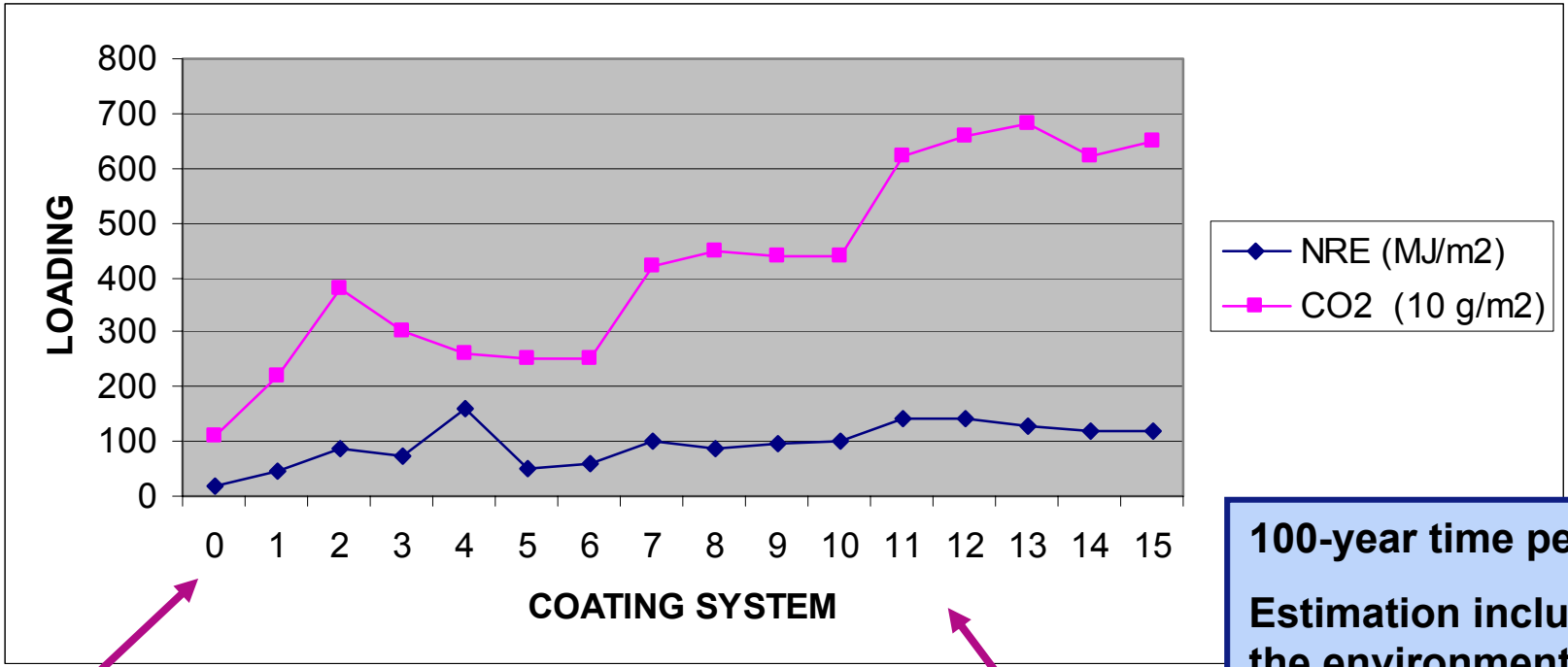
RESEARCH RESULTS OF LIFE CYCLE IMPACTS OF WOODEN EXTERIOR WALLS

- **Environmental Impact of Coated Exterior Wooden Cladding**
- Tarja Häkkinen, Pirjo Ahola, Leila Vanhatalo, Arja Merra
- Service life systematics of coated exterior claddings in connection to environmental assessment
- Functional unit in the LCI was one square metre of coated exterior cladding during a 100 year service life in outdoor exposure in Finland.
- The inventory covered production of coating raw materials and coatings, all transportation, application, maintenance and renewal of the coating during the 100 years including recycling and final disposal.

oating systems

	Primer	Undercoat	Topcoat	Renewal perio
		Swedish red paint	Swedish red paint	10
	Primer with ZnO pigment	Linseed oil undercoat	Linseed oil topcoat	10
	Primer with ZnO pigment	Linseed oil undercoat	Linseed oil topcoat	10
	SB priming oil	SB stain	SB stain	5
	WB priming oil	WB stain	WB stain	5
	SB priming oil	WB stain	WB stain	5
	SB priming oil	Alkyd opaque undercoat	Alkyd opaque topcoat	10
	Factory primer	Alkyd opaque undercoat	Alkyd opaque topcoat	10
	WB priming oil	WB acrylic stain	WB acrylic stain	5
	SB priming oil	WB acrylic stain	WB acrylic stain	5
	SB priming oil	SB alkyd opaque undercoat	Acrylic opaque topcoat	10
	SB priming oil	Acrylic opaque topcoat	Acrylic opaque topcoat	10
	Factory primer	Acrylic opaque topcoat	Acrylic opaque topcoat	10
	WB priming oil	SB alkyd opaque undercoat	Acrylic opaque topcoat	10
	WB priming oil	Acrylic opaque topcoat	Acrylic opaque topcoat	10

Effect of coating system on environmental loadings



100-year time perio

Estimation includes the environmental burdens of wooden exterior wall

0 = reference level, exterior wall without coating
1 ... 15 walls coated with alternative coating systems

TOOLS FOR LCA - BECOST

- www-based tool for
  - life cycle assessment of building structures and buildings,
  - comparing environmental profiles of structures having the same functional units;
  - comparing environmental impacts of materials choises in structures.
- the program includes
  - Environmental profiles, costs and maintenance costs of building materials produced in Finland,
  - The structures of outdoor walls, indoor walls, roofs, floors, etc.
  - Material quantity calculations
  - Environmental profile calculation for designed structure
- result is presented in terms of
  - environmental profile (emissions, energy- and raw-material use)
  - life-cycle cost impact.
- user
  - defines the building by making relevant choices, by
    - by choosing structures and materials,
    - gives volumes in m2,

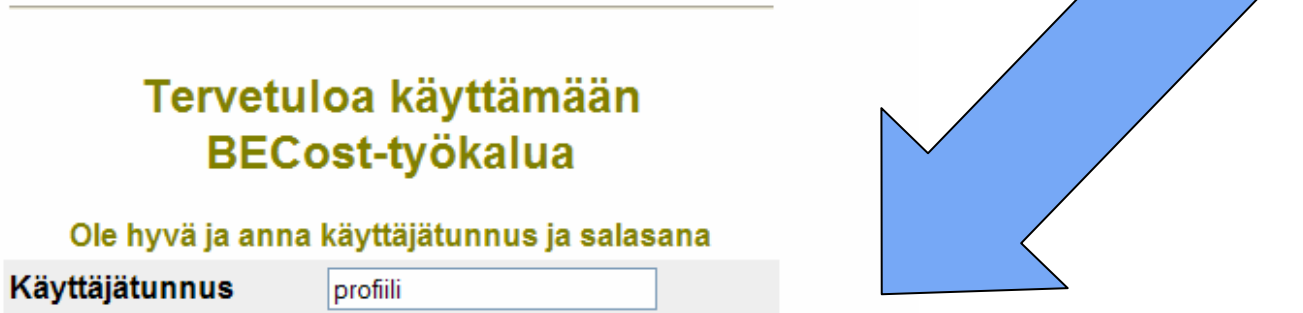

BeCost
Ohje LOGOUT
Talon rakenteet
Ulkoseinä
Väliseinä
Välipohja
Alapohja
Yläpohja
Sokkeli
Kalliorakenteet
Tunneli 13 m2
Tunneli 34 m2
Tunneli 58 m2
Tunneli 66 m2
Kalliotila 80 m2
Kalliotila 278 m2
Avolouhinta
Käytönaikainen energia
Ulkoseinä
Kohde: METLA
Tarkastelujakso (v): 60
Rakenteen nimi: EXTERIOR WALL
Pinta-ala (m2): 56
Rakennekerros
Valitse materiaali
1 Pinnoite Akrylaattimaali puupinnoille
2 Ulkokuori Pystylomalaudoitus +vaakalaudoitus
3 Tuulensuoja Kipsikartonkilevy
4 Koolaus Koolaus (50x123xk600 mm)
5 Lämmöneriste 1 Vuorivilla (esim. 30 kg/m3))
6 Koolaus Koolaus (50x123xk600 mm)
7 Lämmöneriste 2 Vuorivilla
8 Koolaus -

BECOST

http://ce.vtt.fi/cocoon/becost

User name profiili

Pass word name profiili



SERVICE LIFE DESIGN OF WOODEN STRUCTURES

- METLA CASE:
  - Service life target was stated by Senate Properties
  - Design service lifes were stated for building parts and structures on the basis of the building specific service life target
  - Service life of wooden structures were estimated with help of ENNUS PUU

- ENNUS®-programmes have been developed for service life assessment of building structures for designers.
- The programmes help designers to determine parameters that affect the service life of the structure under scrutiny.
- Parameters include materials, details, workmanship, outdoor and indoor conditions, use conditions, and care and maintenance (ISO 15 686).
- User makes choises with help of menus.
- The programme calculates the estimated service life.
- The programme shows the direction and significance of different kinds of structural etc. choises
- ENNUS® tools for concrete out door walls and balconies, steel facades and roofings, and for wooden outdoor walls.

Puujulkisivujen käyttöikämitoitus kerroinmenetelmällä

Ennus-Puu

Valitse varmuustaso

95 %

Valitse rakenne

Julkisivut

	Käyttöikä	**60**
RSLC	**RSLC (vertailukäyttöikä)**	**40**
A1	**Puumateriaali**	**1,0**
A2	**Pintakäsittely**	**1,1**
B	**Suunnittelu / rakenteet**	**0,9**
C	**Rakentaminen / toteutus**	**1,7**
D	**Ilmasto-olot**	**0,6**
E	**Sisäolot**	**1,0**
F	**Huolto**	**1,5**

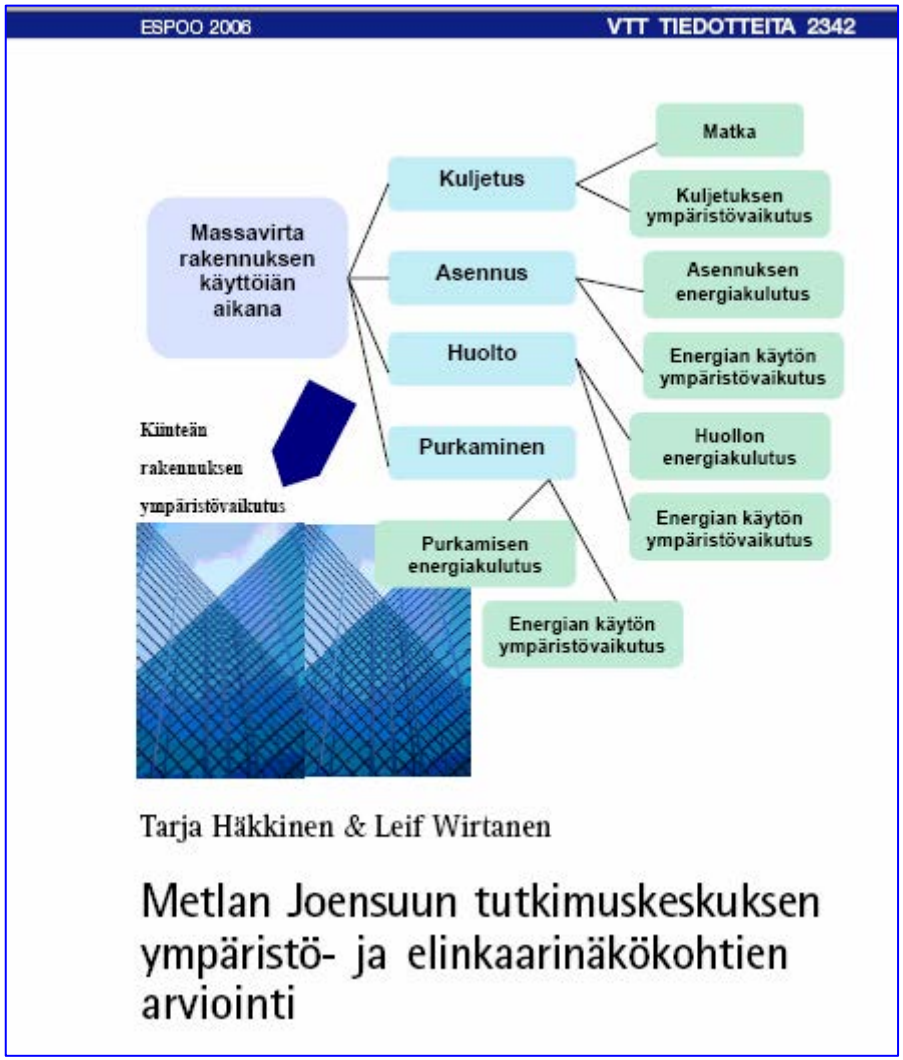
Hannu Viitanen

VTT Materiaalit ja rakentaminen

päivitys
14.3.2006

SUMMARY - BUILDING FOR SUSTAINABILITY

- Important features of sustainable building projects:
- Target setting by the owner
- Design for
  - energy efficiency and good indoor conditions
  - service life, maintenance and flexibility
  - low environmental impacts



http://www.vtt.fi/inf/pdf/tiedotteet/2006/T2342.pdf

Address http://virtual.vtt.fi/environ/index_e.html

Suomeksi

Picture: Juha Juntunen, VTT

Home page

- Environmental declarations
- Environmental classification
- Life Cycle Assessment
- Sustainability indicators
- Requirement management
- Service life information
- Product libraries
- Tools for LCA
- Tools for producers
- Service life estimation

LIFE CYCLE TECHNOLOGY

VTT has developed national methods for environmental management of buildings and building products together with the actors of the Finnish building and real estate sector. These include the method for the environmental assessment and environmental declarations of building products (EKA method) and the classification method for buildings (PromisE). VTT formulates environmental declarations and certificates for building products according to the EKA method principles (sea also RTS and VTT certificates).

VTT is one of the pioneers in developing and applying methods of LCA for the analyses of buildings and building products. VTT is an active partner and actor in the international cooperation and standardisation in the field.

VTT is internationally an active partner and actor in the development of sustainability indicators and methods for requirement management (for example EcoProP).

VTT is forerunners in the development of life cycle information management and integration with product model design (for example LifePlan concept), (see also Information management of construction). The development of life-cycle information as part of product-specific information and product libraries is one of the focuses.

VTT has developed tools for environmental assessment tools in order to support consideration of environmental aspects in building design. For example the BECOST

http://virtual.vtt.fi/environ/index_e.html