



Sustainability ratings for homes[®]

Case: Single family home, 2007

FIGBC

24 Jan 2011, Sitra, Helsinki FI

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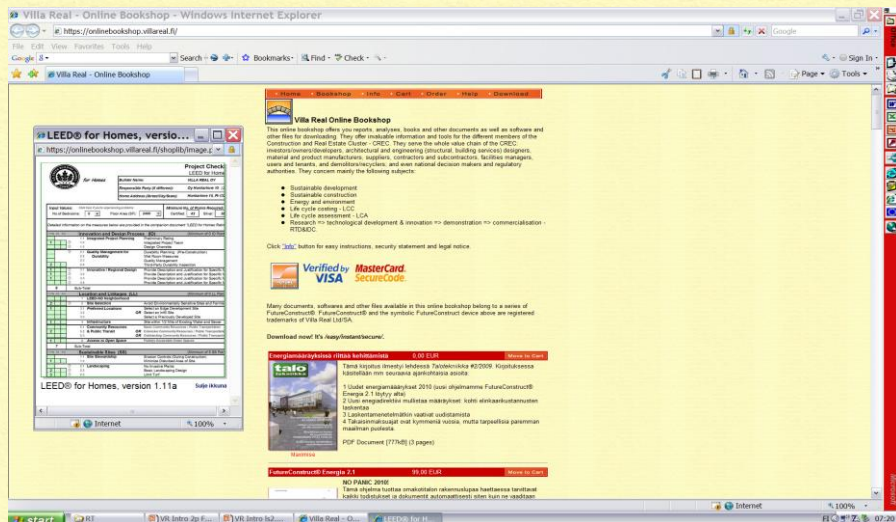
VILLA REAL[®] for Sustainable Construction[®] (1)

- **We offer engineering and consulting services to the international clientele of the Construction and Real Estate Cluster - CREC:**
 - On **technological, economic and sustainability** topics in general
 - To advance energy efficiency towards "**zero energy houses**", in the stages 4...5 of the RTD&IDC chain "research ⇨ technological development & ⇨ innovation ⇨ demonstration ⇨ commercialisation"; design, software, equipment
 - Advanced **FutureConstruct[®] software and services** for investors, developers, designers, contractors and users:
 - (1) to produce necessary **energy certificates and documents** to fulfill the EU directive of the energy performance of buildings in Finland (eg **FutureConstruct[®] Energia 2.1** good for new regulations 2010 in Finland)
 - (2) thru **Total LCC** calculations utilising the newest science to **monetise externalities and intangibles** (occupational, mobility, environmental and societal impacts)
 - (3) utilising the newest science and software to **replace deterministic singular values for costs and performance with a probabilistic approach - LCCP**
 - **Post Occupation Evaluation – POE** using the **BUS** method licensed from the UK. This is to find out the suitability of the newly completed (office) building to it real use.
- We develop and sell related **software**, available in our **Online Bookshop**
- We publish related **books, reports and analyses**, available in our **Online Bookshop**
- **Keywords characterising our experience:** International • Strategic • **Sustainable** • **Energy & Environment** • **Construction** • IT & Robotics • RTD&IDC
- Our **clients** include several leading European contractors and manufacturers, Shimizu Corp. Japan, Singapore Ministry of National Development, the European Commission, and numerous European, Nordic and Finnish CREC organisations

Further information available: www.villareal.fi



VILLA REAL® for Sustainable Construction® (2)



Contents

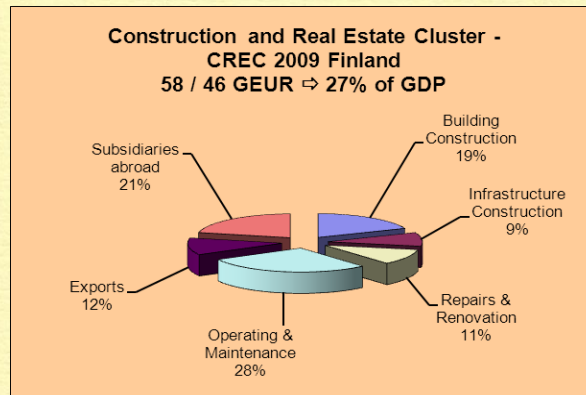
- Construction and Real Estate Cluster – CREC for sustainability
- What are LCA and LCC – Standards & Ratings
- Case: Single family home, Ratings: VILLA REAL, Honkarinne 10, National Housing Fair, Hämeenlinna 2007
- Future development

Low energy house at the Finnish National
Housing Fair 2007, completed by Villa Real Ltd.



The Construction and Real Estate Cluster – CREC for sustainability

- While in Finland construction represents 10% of GDP (or 13% if repairs & renovation are counted in), CREC represents 27% of the same GDP. The same total is true for the EC 15 / 27.



Why sustainable construction is important?

- In advanced European vocabulary "construction" is considered to cover the entire value chain of develop/own, design, manufacture, construct, recycle a building, infrastructure or other constructed assets.
- Today in Finland and elsewhere, an expression **Construction and Real Estate Cluster - CREC** has been taken to use to cover all activities directly related to construction and real estate (buildings, infrastructure and other facilities = 60-70% of the national wealth). Compared to the above, CREC covers the whole life of a building, hence additional activities concern operating and maintaining the building, which more often is done by facilities management.
- A reason to this approach is the fact that major contractors are moving from plain construction towards taking care of the building/facility for a certain period or its whole life. Also public-private partnership – PPP projects (BOOT, PFI; toll roads & bridges, schools, prisons etc) require this approach. All investors and property developers need this.
- Buildings consume 40% of total energy and account for 30% of CO₂ emissions, thus environmentally alone, CREC's sustainability is most important for whole society!**

Could this be sustainable construction?

- The ways in which built structures are procured and erected, used and operated, maintained and repaired, modernised and rehabilitated, and finally dismantled (and reused) or demolished (and recycled), constitute the complete cycle of sustainable construction activities.
- Minimise the use of **materials**, **energy** and **water** and **mobility**. (factor 4/10; NL: factor 20; Passive House, Zero Energy House etc)
- Building products should, as far as possible, be **reusable** and materials **recyclable**. Design for **long service life** (and durability) is superior to design for reusability. Reusability is superior to recycling, and recycling is superior to waste disposal.
- In sustainable construction, reusability and ease of **changeability** are necessary product properties, in particular for modular products and systems with different service lives.

What are LCA and LCC? (1) Regulatory framework

- It is good to realise that as an EU member state, Finland must comply with the generic EU administrative structure and procedures. For various CREC regulations the practical order is as follows:
 - EU Directive ⇒
 - CEN Standards: mostly in accordance with ISO standards ⇒
 - National regulations: must comply with the above ⇒
 - Voluntary Evaluation/Assessment/Calculation methods (such as LEED, BREEAM, PromisE, FC Sustain etc for sustainable construction): must comply with the above



What are LCA and LCC? (2) ISO Standards

- Derived from **ISO 14040**: In the Construction and Real Estate Cluster - CREC, environmental life cycle assessment - **LCA** is for assessing the total **environmental impact** associated with a product's manufacture, use and disposal and with all actions in relation to the construction and use of a building or another constructed asset. **LCA does not address economic or societal aspects!**
- Derived from **ISO 15686***: In CREC, Life cycle costing - **LCC** is a technique which enables **comparative cost assessments to be made over a period of analysis**, taking into account all relevant economic factors both in terms of initial capital costs and future operating costs less residual value. It can be defined as the net present value - **NPV** of the total costs of an asset over the period of analysis.

*ISO 15686-5 (2008) Buildings and constructed assets – Service life planning - Life cycle costing: life-cycle costing = methodology for systematic economic evaluation of life-cycle costs over a period of analysis.



What are LCA and LCC? (3) LCC & ISO 15686 (2009)

This new standard covers 10 parts: 8 parts are ready and the remaining parts advanced, and the first part "umbrella standard" already under revision. The proposed ten parts are as follows:

- ISO 15686-1 "General Principles" deals with issues and data needed to forecast service lives and gives a method for estimating the service lives of components and assemblies; umbrella standard; approved 2000, a revision to be approved soon.
- ISO 15686-2 "Service Life Prediction Procedures" describes a generic method for using testing of performance of components and assemblies to provide a service life prediction; approved 2001.
- ISO 15686-3 "Performance audits and reviews" provides tools for audits and reviews to ensure that relevant steps have been taken to achieve a service life that will match or exceed the design life; approved 2002.
- ISO 15686-4 "Data requirements" is a technical guide on methods of presenting data and evidence to support forecasts; under development
- **ISO 15686-5 (2008) "Life cycle costing" will provide guidance on life cycle costing; approved 15 Apr 2008.**
- ISO 15686-6 "Procedure for considering environmental impacts" provides guidance on assessing environmental sustainability in the context of service life planning; approved 2004.
- ISO 15686-7 "Performance evaluation and feedback of service life data from practice" provides guidance on how to structure and use feedback data on in-use condition; approved 2006.
- ISO 15686-8 "Reference service life and service life estimation" will provide guidance on assessment of default service lives using available information; approved 2008.
- ISO 15686-9, "Inclusion of requirements of service life assessment and service life declaration in product standards"; approved 2008.
- ISO 15686-10, "When to assess functional performance"; to be approved soon.

What are LCA and LCC? (4) CEN, ISO and US (2010)

- Also elsewhere standardisation is in a good progress:
 - “CEN/TC350 – prEN 15643 Sustainability of construction works - Assessment of buildings - Parts 1-4”.
 - “ISO 21929-1 Building Construction - Sustainability in Building Construction - Sustainability Indicators”, etc.
 - In the USA new standards just approved, ahead of the EU: “ANSI ICC 700-2008 National Green Building Standard” (2009) and “ASHRAE Standard 189-2010 for the Design of High-Performance, Green Buildings” (2010).

What are LCA and LCC? (5) LCA Assessment Methods (1)

- Some 100 national and other LCA methods and computer software developed. All are different by approach and criteria. Results are scorings and points and difficult to understand (the same building can get eg 4.2, 123 or 820 points depending on the method used).

LCA Tools (~2004)		LCC Tools	
Name of software	Country of origin	Name of software	Country of origin
BREEAM	GB	Kiinteistötesti	FI
ENVEST	GB	Arskosthadanalys	NO
Eco-Quantum	NL	Kostenreferentiemodel	NL
GreenCalc	NL		
ECO-PRO	DE	Total LCC (2011)	FI
LEGOE	DE	Total LCCP (2017)	EU
HQE	FR		
EQUER	FR		
OGIP	CH		
Miljøstatus	SE		
Okoprofi	NO		
BEAT 2002	DK		
Ekometri	FI		
Ekosario	FI		
TAKE	FI		
LEED	US		
BEEES	US		
Green Globes	CA		
ATHENA	CA		
CASBEE	JP		
NABERS	AU		
GBTool (by IISBE)	(24 X NN)		
FutureConstruct®	FI, GB, DK, NL, IT, ES, PT, GR		
Promise	FI		



What are LCA and LCC? (6)

LCA Assessment methods (2)

- **LEED**® (The Leadership in Energy and Environmental Design by the US Green Building Council). Now used in over 70 countries.
- **BREEAM** (BRE Environmental Assessment Method; GB). Now used in over 20 countries, mostly EU states.
- **FutureConstruct**® **Sustain 1.0**, developed by 8 EU member states under EuroLifeForm project, and good for different periods of analysis(!).
- In the following table a rating comparison is presented. Scoring for rating class limits is shown for FC Sustain only, the points are percentages ie max = 100% for the best standards and practices; presented here as absolute values, which might be the most illustrative way for presentation and generic understanding.

Method / Rating						
LEED®		Certified	Silver	Gold	Platinum	
BREEAM		Pass	Good	Very Good	Excellent	Outstanding
FutureConstruct® Sustain *	Poor <0.50	Average 0.50 - 0.60	Satisfactory 0.60 - 0.70	Good 0.70 - 0.80	Very Good 0.80 - 0.90	Excellent >0.90



Matalaenergiatalo VILLA REAL (1)

Kuvaus (1)

- Honkarinne 10, FI-13270 Hämeenlinna
- 7h + k + 2 at, huoneistoala 220 + 42 m² hyvään asumiseen





Matalaenergiatalo VILLA REAL (2)

Kuvaus (2)

- Yksilöllinen & integroitu suunnittelu (5 eri suunnittelijaa alusta asti)
- Pääsuunnittelija Olavi TUPAMÄKI, DI RIL



Matalaenergiatalo VILLA REAL (3)

Kuvaus (3)

Energiansäästöjärjestelmä 3.1:

- **1 Hyvä lämmöneristys:** Tarkoittaa sitä, että talon ulkoseinät, ala- ja yläpohjat sekä ikkunat ja ovet, eli talon koko kuori, eristävät hyvin lämpöä. (Siporex seinä $U=0.21 \text{ W/m}^2\text{K}$; parempia löytyy, mutta ei yksiaineisia)
- **2 Tiivis talo:** Vaikka seinistä ei johtuisikaan lämpöä ulos, harvasta talosta lämmin sisäilma kuitenkin karkaa harakoille. Niinpä talon tulee olla mahdollisimman tiivis. (laskettu vuotoluku=1.0; Siporexilla onnistuu helposti)
- **3 Tehokas lämmön talteenotto ilmanvaihdossa:** Koneellinen ilmanvaihto on nykyään käytännössä pakollinen. Tällöin on tärkeää, että ilmanvaihto-koneen lämmön talteenotto (LTO) on mahdollisimman tehokas eli vuosihyötysuhde mahdollisimman korkea. (Enervent pyörivä, vhs=77 %)
- **.1 Energialähteen valinta:** Tärkeintä on, että talo kuluttaa vähän energiaa. Sen jälkeen energialähteen voikin valita varsin vapaasti; kaikki energialähteet voivat tulla kysymykseen. Kun energian hinta vääjäämättömästi nousee, näyttäisi lämpöpumppu hyvältä ratkaisulta; tuottaahan se jopa yli 4 kertaa enemmän lämpöenergiaa kuin käyttää sähköä. (Ekowell, vhs=4.0)



Matalaenergiatalo VILLA REAL (4) Luokitukset (1)

Tehdyt luokitukset:

- **Tekninen elinkaari laatu:**
 - Tähtiluokitus [FI]: 5 tähteä kaikilla arviointialueilla
 - Rakentajan Ekolaskuri [FI]: Hyvin ympäristöystävällinen
- **Energialaskelmat**
 - Energiatodistus [FI]: A++
 - Energiankulutus ja -kustannukset [FI]: Lähes passiivitalo
- **Ympäristövaikutukset**
 - LEED® for Homes 1.11a [US]: Platinum
 - FutureConstruct® Sustain 1.0 [EU]: Very good (25 sekä 50 a aikajänne)



Matalaenergiatalo VILLA REAL (5) Luokitukset (2)

Tähtiluokitus [FI]

- Oulun Asuntomessujen 2005 yhteydessä kehitetty pientalon teknisen laadun arviointiin ja optimointiin soveltuva menetelmä. VILLA REAL sai kaikilla neljällä arviointialueella korkeimman arvosanan viisi ⇒ "5 tähteä".



Rakentajan Ekolaskuri [FI]

- Ekolaskuri on Helsingin kaupungin rakennusvalvontaviraston toimeksiannosta ja ympäristöministeriön rahoittamana syntynyt ympäristövaikutusten arviointimenetelmä. VILLA REAL sai 72.75 pistettä, mikä tarkoittaa sitä, että talo on "hyvin ympäristöystävällinen".



Matalaenergiatalo VILLA REAL (6) Luokitukset (3)

Energiatodistus [FI]:

- ET-luku = $112 \text{ kWh/m}^2\text{a}$ $\Rightarrow$ "A++" (luokka A $<150 \text{ kWh/m}^2\text{a}$).
- Ostoenergian ET-luku = $65 \text{ kWh/m}^2\text{a}$
 $\Rightarrow$ kallioliämpöpumppu

FutureConstruct® Energia

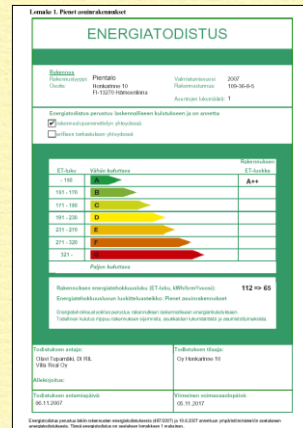
Yhteenveto: ET-luku: 112 kWh/m²a, Ostoenergian ET-luku: 65 kWh/m²a

Luokitus: A++

Yhteenveto: Ostoenergian ET-luku: 65 kWh/m²a

Yhteenveto: Ostoenergian ET-luku: 65 kWh/m²a

Necessary software FutureConstruct® Energia 2.1.1 is available
at <https://onlinebookshop.villareal.fi>



Matalaenergiatalo VILLA REAL (7) Luokitukset (4)

Energiankulutus ja -kustannukset [FI]:

- D5: Energiankulutus = tilojen lämmitys (...d/a) + kivilattioiden mukavuus-lämmitys (365 d/a) + käyttöveden lämmitys (365 d/a) + taloussähkö (365 d/a)

FutureConstruct® Energia

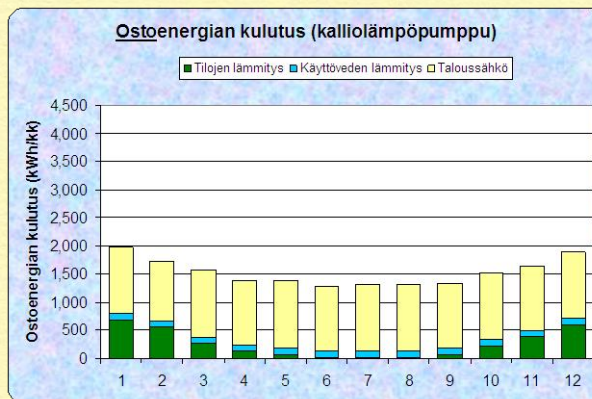
Yhteenveto: Energiankulutus: 112 kWh/m²a, Ostoenergian ET-luku: 65 kWh/m²a

Luokitus: A++

Yhteenveto: Ostoenergian ET-luku: 65 kWh/m²a

Yhteenveto: Ostoenergian ET-luku: 65 kWh/m²a

Necessary software
FutureConstruct® Energia 2.1.1
is available at
<https://onlinebookshop.villareal.fi>





Matalaenergiatalo VILLA REAL (10) Luokitukset (7)

FutureConstruct® Sustain 1.0 [EU]:

- Ohjelmalla voidaan arvioida rakennuksen vaikutuksia monipuolisesti: ei vain ympäristövaikutuksia, vaan myös rakennuksen tehokkuuden/mukavuuden merkitystä, sen aiheuttamaa liikennettä sekä vaikutusta yhteiskuntaan yleensä. Ainoa ohjelma, jolla voi tarkastella haluttua ajanjaksoa. VILLA REAL sai arvosanan **"Very Good"** eli erittäin hyvä; 50 vuoden tähtäimellä tulos on 88 ja 25 vuoden tähtäimellä 84 pistettä = prosenttia. Lokalisointi ja suomentaminen pikku juttu.

Necessary software
FutureConstruct® Sustain 1.0
is available free of charge at
<https://onlinebookshop.villareal.fi>

FutureConstruct® Sustain				
VILLA REAL Ltd/SA, Espoo Finland				
Project:	HLAM 22 - VILLA REAL			
Phase:	Client Brief	No		
	Concept Design	No		
	Detailed Design	Yes		
Completed by:	Olavi TUPAMÄKI			
Date:	11 Jun 2007			
Design Life (years)	Phase	Weights Principal (%)	Impacts	Weights Impact (%)
100				
Period of Analysis (years)				
25				
Environment	Construction	100	Energy	25
			Sum	
			Materials	50
			Sum	

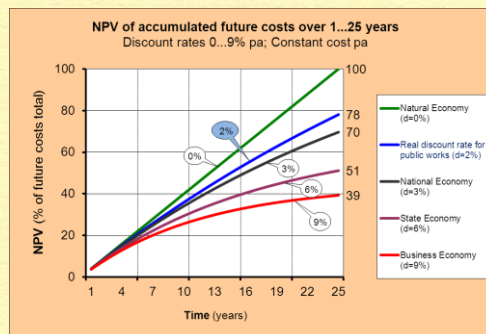


Future (1) Total LCC & Probabilistics (1)

Total LCC [FI] ⇒ with probalistics ⇒ Total LCCP EU]:

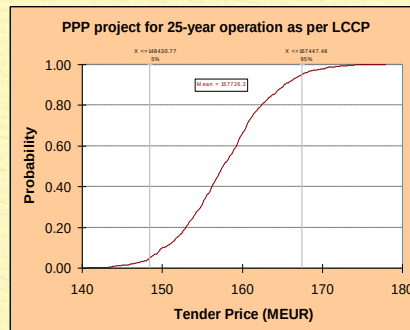
- Total LCC is to cover not only the initial capital and direct future costs of a building or another constructed asset but also externalities and intangibles** (occupational, locational, environmental and societal impact costs). To put it simply, Total LCC just tries to **convert all various LCA impacts to money**.
- After this **monetarisaton** everything can be calculated mathematically as LCC = NPV of all effective costs over the period of analysis as already envisaged in ISO15686-5.

$$NPV = \sum_{t=1}^N \frac{C_t}{(1+d)^t}$$



Future (2) Total LCC & Probabilistics (2)

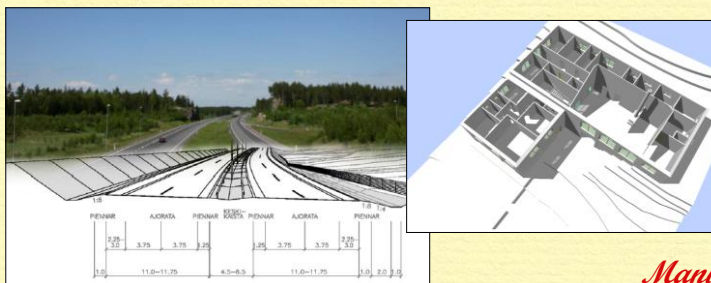
- For LCC to become widely accepted, concerns about uncertainties in forecasting must be overcome: costs and performance of a building, its components, systems and assemblies. A software pack **FutureConstruct® LCCP** was developed in 3.8 MEUR project **EuroLifeForm** (I was the originator) to make this practically possible.
- I am confident that **eventually the Total LCC/LCCP will be taken to use in the EU**. Via directives and supportive standards they'll replace the existing standards, national regulations and assessment/rating tools we are discussing today. It was already initially approved in 2001 by the task group TG4 of the EC DG Enterprise! This is also envisaged in ISO15686-5.
- As an action towards a LCC Directive, Davis Langdon Ltd prepared 2007 a report **"Life cycle costing (LCC) as a contribution to sustainable construction: a common methodology"**, duly covering Total LCC with Probabilistics.



Sustainability ratings for homes Where to find more?



- All the aforesaid and much more is available in Villa Real **Online Bookshop** www.villareal.fi or directly at the secured <https://onlinebookshop.villareal.fi>.
- Most of the documents, software etc are available free of charge. Our streamlined download process is **easy/instant/secure!**. For payment, if any, **MasterCard SecureCode** and **Verified by VISA** double your security.
- Käy (!) myös kaikille avoimella blogisitellä <http://energiatyhmyrit.blogspot.com/>.



Many thanks!