






**Environmental methods
and tools to identify and
classify sustainability of
buildings
(SBA - LiderA)**
13/4/2007
Manuel Duarte Pinheiro



**LiderA
Main Topics**

- 1. Building Environment Assessment Need and Context**
- 2. Environmental methods and tools (Summary)**
- 3. LiderA Approach (Framework),**
- 4. LiderA Cases**
- 4. Further Developments**


Need and Context

Methods

Further Developments

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Sustainable Assessment

Need and Context





Need and Context

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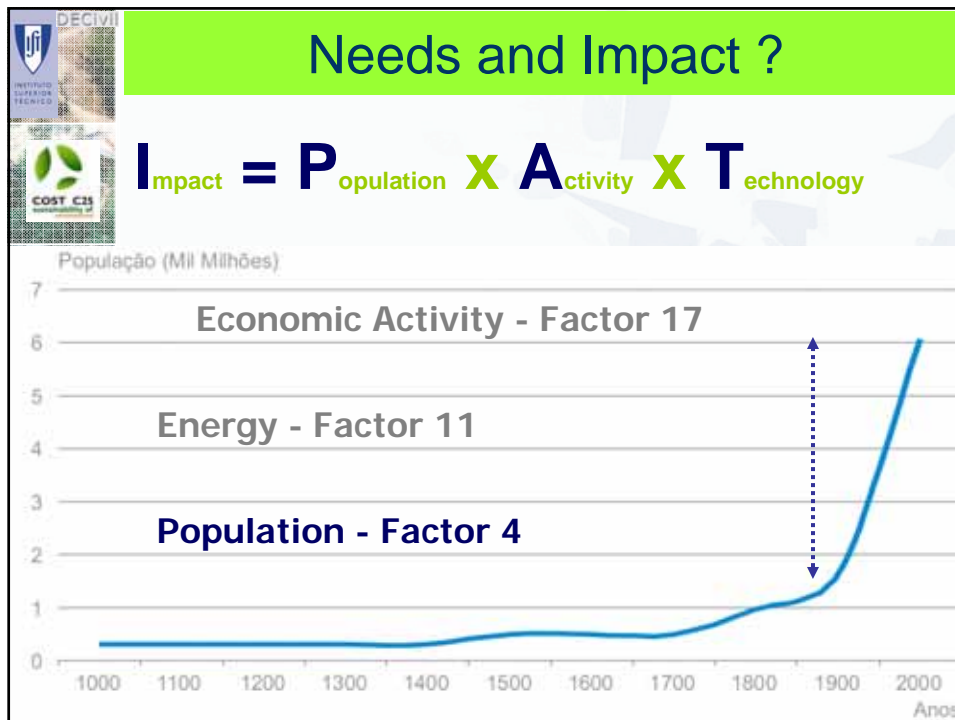
Sustainable Development

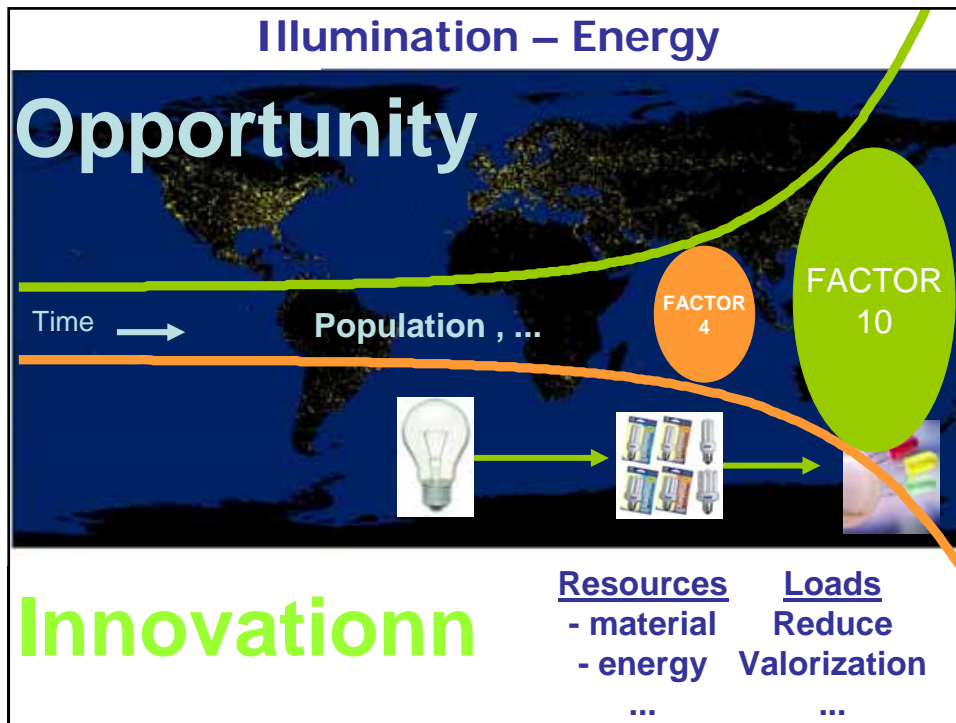


“Development that meets the needs of the present without compromising the ability of future generations to meet their own needs”

Needs	Support Capacity
	

Weak and Strong





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Sustainable construction

➤ Agenda 21;

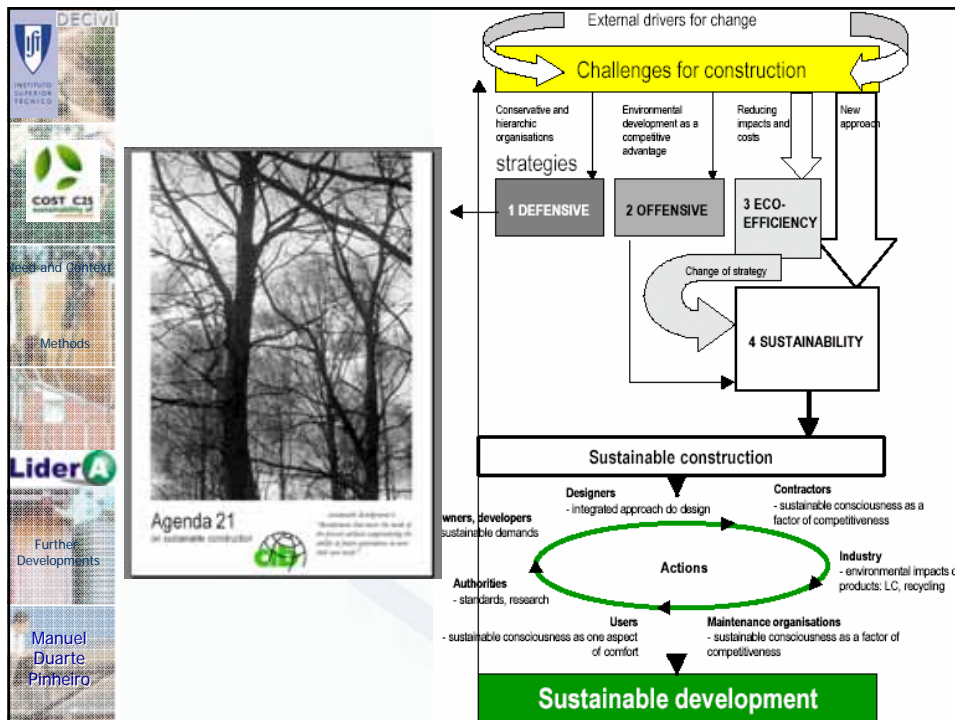
Sustainable Construction

‘The creation and responsible maintenance of a healthy built environment based on resource efficient and ecological principles’

Kibert, Charles (Tampa, 1994)

Activity Works

Product Buildings



Sustainable building looks to the entire life cycle of a building and considers that the construction resources are constituted by the materials, the soil, the energy and the water.

- From these resources, Kibert established the five basic sustainable building principles:
 - 1. Reduce resource consumption;
 - 2. Reuse as much resources as possible;
 - 3. Recycle the buildings end of life materials and use recyclable resources;
 - 4. Protect natural systems and their functions in all activities;
 - 5. Eliminate toxic materials and its sub products in all life cycle phases.



<http://www.iisbe.org/annex31/c>

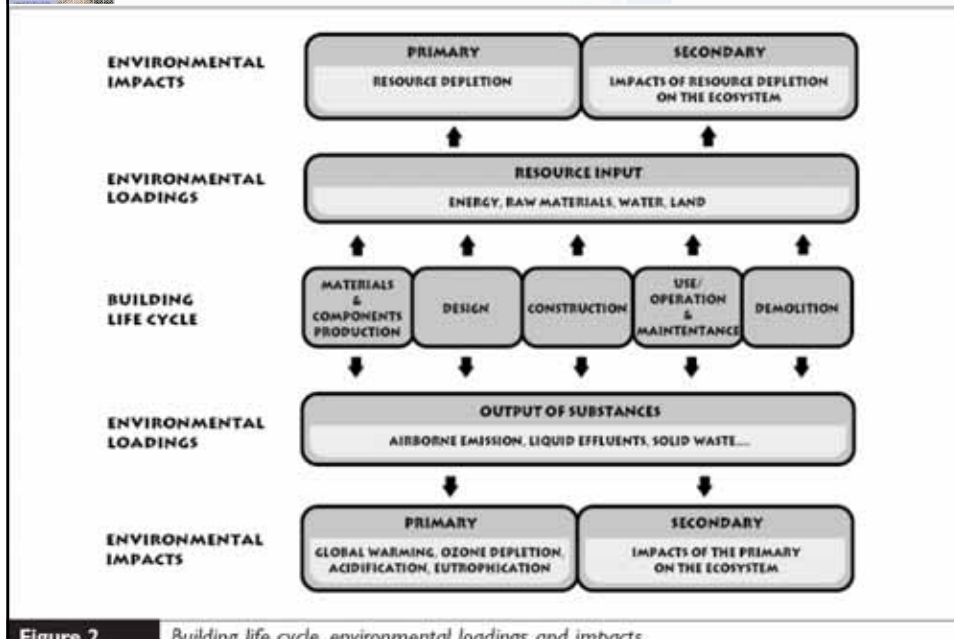
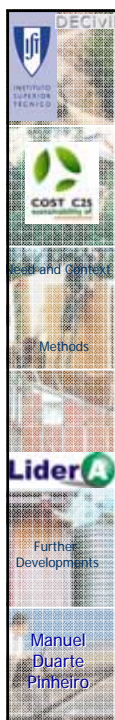


Figure 2 Building life cycle, environmental loadings and impacts



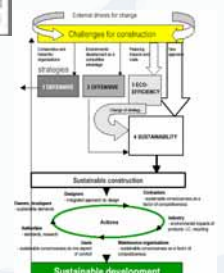
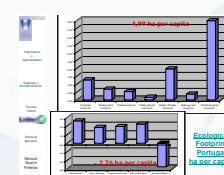
Sustainable Building ?

➤ Environmental impact

- Energy Consumption
- Air Quality and Health
- Soil Use / Natural Areas
- Water Consumption and Management

➤ International Sustainable Construction Trends

➤ “Green Buildings”



Need do have an sustainable assessment system (Buildings)

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Sustainable ?

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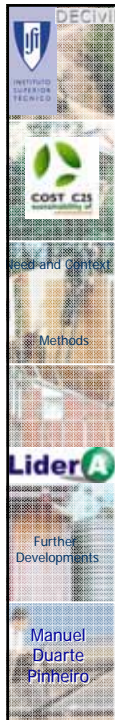
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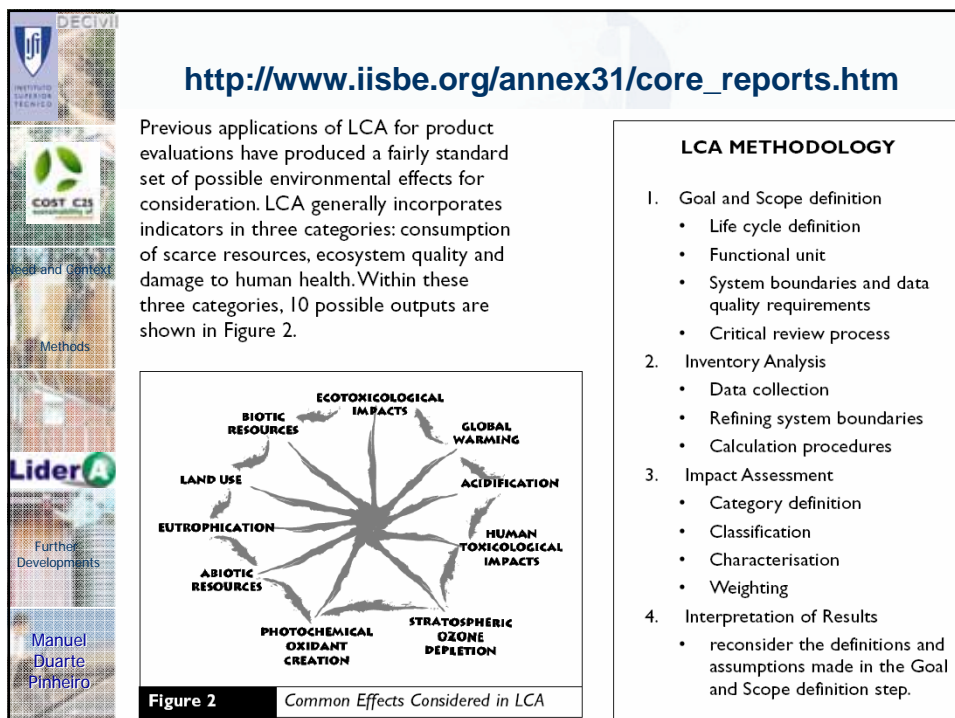
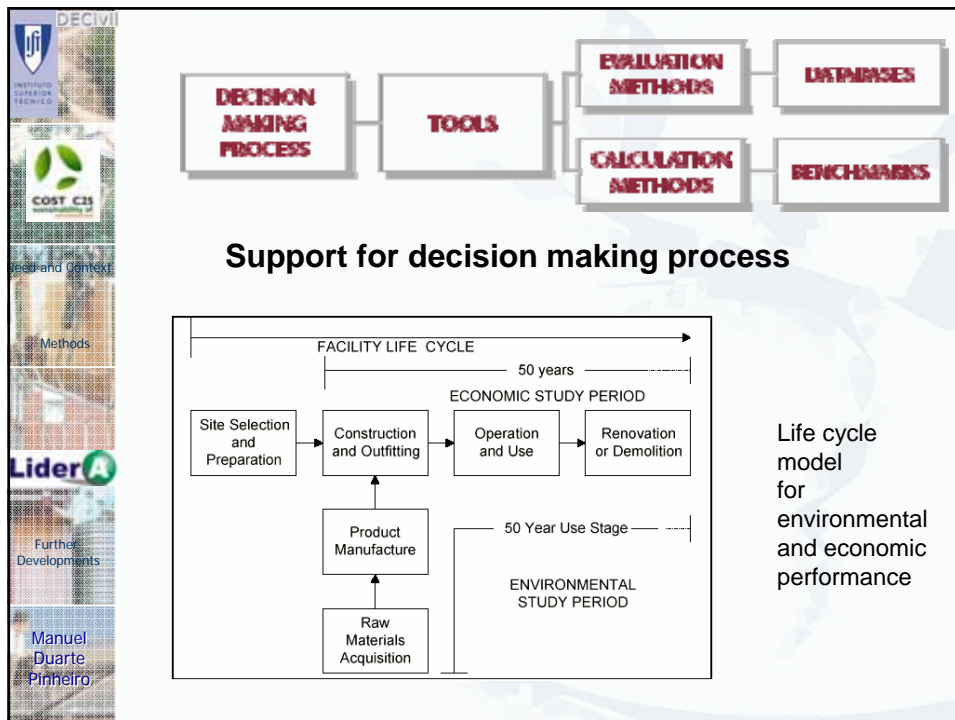
Environmental Methods and Tools Sustainable Assessment





Several Methods and Tools

- Support project /Solution: Prescriptive Criteria or Systems (Define solution, ...), ...
- Assess : **LCA**; LCC; **SBA** (Sustainable Built Assessment), potential Label, ...
- Environmental Management: ISO 14001, ...


LCA



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General LCA Software


Software	Producer	Licences	Database Modules
GaBi	IKP/PE	220	2500
Team	Ecobilan	90	7000
Pia	TME	*	200
Sima Pro	Pre consultant	300	300
LCA it	Chalmers	100	106
Umberto	IFEU	120	200
Boustead Model	Dr. Boustead	60	4500
EUKLID	IVV	9	900
Battelle	Batelle	*	*
Lims	Chem System	*	400
EcoPro	EMPA	13	1000
Repaq	Franklin Associates	5	85
IDEMAT	TU Delft	*	*

Apresentação do Profº Arpad Horvath, Juno 2003, IST - Source: Siegenthaler, C. P.; Lindner, S.; Pagliary, F : Ökobilanzsoftware Marktübersicht 1997, February 1997, Sinum GmbH, Switzerland

Read and Context




Methods





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Example LCA Software

Example Programs		
	Tools	Applied
  <p>Read and Context</p> <p>Methods</p>  <p>Further Developments</p> <p>Manuel Duarte Pinheiro</p>	BEES	Environmental performance, <i>Desempenho ambiental; edifícios sustentáveis, avaliação ciclo de vida e custo</i>
	Envest	Environmental performance; edifícios sustentáveis, análise ciclo de vida e análise de impacto
	EQUER	LCA análise ciclo de vida, apoio no projecto de edifícios residenciais, comerciais e simulação
	LISA	LCA, embodied energy
	Athena	LCA, construction material
	Building Greenhouse Rating	Energy (GEE) Energia operacional, emissões de gases de estufa, comparação (austrália)

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Software BEES

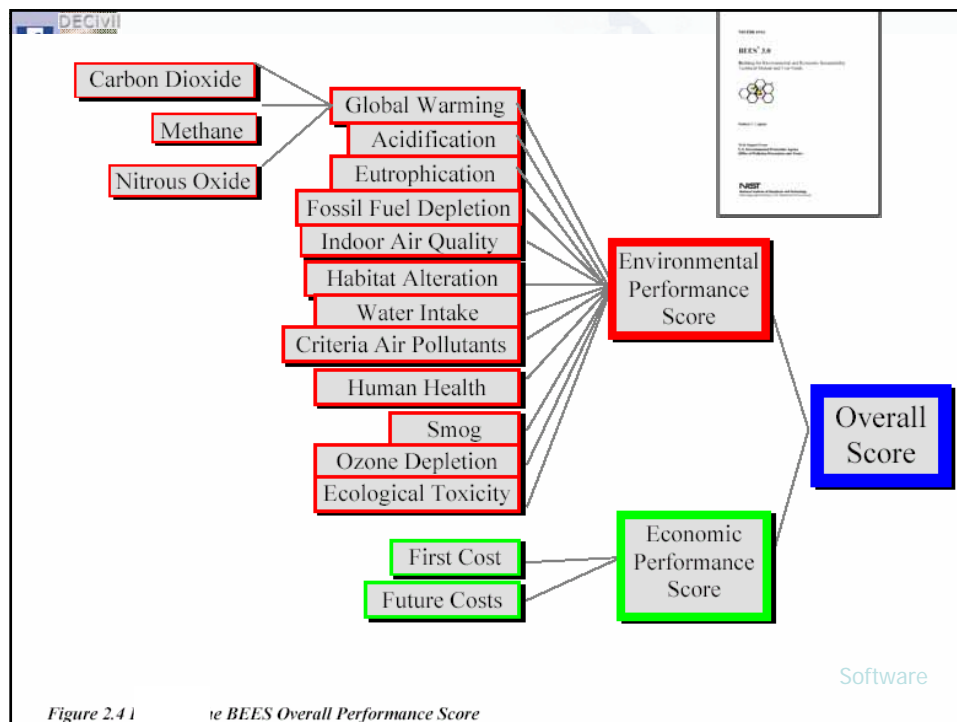


FREE

➤ **BEES**

The BEES (**B**uilding for **E**nvironmental and **E**conomic Sustainability) software brings to your fingertips a powerful technique for selecting cost-effective, environmentally-preferable building products. Developed by the NIST (National Institute of Standards and Technology) [Building and Fire Research Laboratory](#) with support from the [U.S. EPA Environmentally Preferable Purchasing Program](#), the tool is based on consensus standards and designed to be practical, flexible, and transparent. Version 3.0 of the Windows-based decision support software, aimed at designers, builders, and product manufacturers, includes actual environmental and economic performance data for nearly 200 building products

Software



Software
LISA

FREE

LISA

<http://www.lisa.au.com>

Introduction
Methods
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Bill of materials

Stage	Item	Component	Material	Amount Unit
	Ceiling lining	Material transport	Road	74 km
		Plasterboard	Plasterboard	1.7 m ²
	Door hollow timber	Decommissioning	Timber - hardwood	0.16 m ³
		Material transport	Road	2.4 km
			Timber - hardwood	0.1 m ³
	Door solid timber	Decommissioning	Timber - hardwood	0.03 m ³
		Material transport	Road	1.5 km
Construction		Aggregate - gravel	Aggregate - gravel	600 kg
		Concrete	Concrete	3.0 m ³
			Steel - reinforcement	85 kg
	Driveway	Decommissioning	Concrete	1.1 m ³
			Steel - reinforcement	25 kg
		Material transport	Road	280 km
			Bricks	230 each
	Floor	Decommissioning	Concrete	0.04 m ³
			Mortar	0.10 m ³
			Steel - reinforcement	0 kg

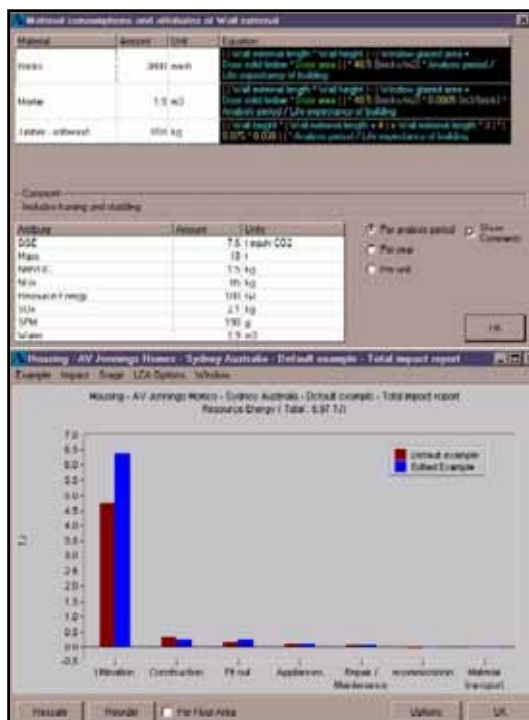
LISA Input:

- Bill of Materials & Quantities (along with possible alternative materials such as concrete which uses fly ash, a waste product from power production as a cement extender. From a sustainability perspective this reduces the need for energy intensive cement production). Work Schedule e.g. Fuel consumption by construction equipment. HVAC, Services and Fittings. Utilisation schedules.

Data is entered into existing interactive case studies to determine the environmental impact (in terms of the sustainability and energy use) of design and material alternatives.

A developer mode exists for those who wish to add their own interactive case studies and findings to the knowledge embodied in the existing case study list. This feature can only be accessed by obtaining a developer password from info@lisa.com.au.

In developer mode equations that relate to material use and service use such as water and electricity are generated. These are typically associated with stages in the life cycle of the building typical stages. Includes but are not confined to: specification, construction, appliances, fitout, utilisation, transportation, decommissioning/recycling, and material transport.



LISA OUTPUT

- **Output:** Output is in graphical and table form showing the environmental impact of each stage in terms of: resource energy use in GJ, GGE in tonnes of equivalent CO₂, SPM, NMVOC, Water, NO_x, and SO_x. Base Material Data and a Bill of Material Quantities are also reported.

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Envest


➤ First UK software for estimating lifecycle environmental impacts of buildings at the early design stage. This version is for office buildings, and considers the environmental impacts of both the materials used during construction and the energy and resources consumed over the building's life.

Using minimal data entered through simple input screens, Envest allows designers instantly to identify those aspects of the building which have the greatest influence on its overall impact.

All environmental impacts are measured using a single points scale called Ecopoints, allowing designers to make direct comparisons between different designs and specifications. One hundred Ecopoints are equivalent to the environmental impact of the average UK citizen in one year.

<http://www.bre.co.uk/envest>

http://www.eere.energy.gov/buildings/tools_directory/software/envest.htm



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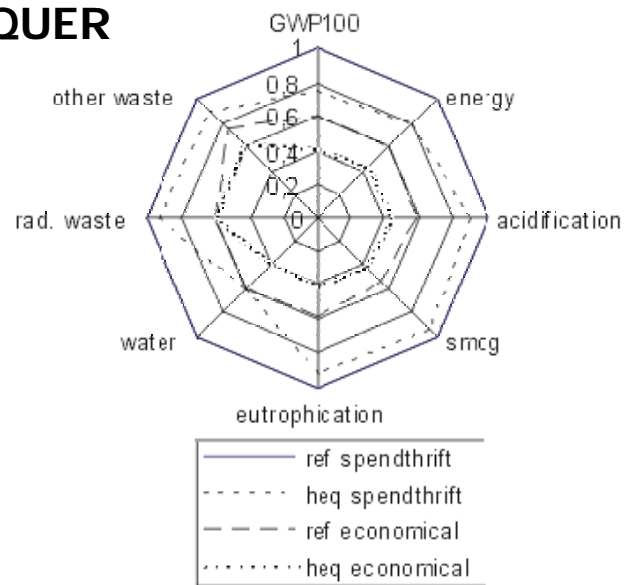
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EQUER




Radar do EQUER life cycle tool (France)

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Software


Building Greenhouse Rating

FREE

- Australiano
- Provides assessments of the greenhouse intensity of office buildings by awarding a star rating on a scale of one to five. Buildings identified by the Australian Building Greenhouse Rating scheme with a high star rating will be more energy efficient and cheaper to run, and will result in lower greenhouse gas emissions. Separate components of the building can be rated - a base building rating measures the performance of those services provided by the building manager/landlord; and a tenancy rating measures the services for which the tenant is responsible. A whole building rating measures the combined effect.



<http://www.abgr.com.au>



Performance Report

Summary Information

Correspondent: Your building rating is 4.0 stars, corresponding to normalised greenhouse emissions of 182 kgCO₂/m²/yr. This is based on a total energy consumption of 1064 MJ/m² per annum. The total actual emissions, uncorrected for use effects is 11 818 000 kgCO₂ per annum. You have a normalised energy consumption of 211 kWh/m²/yr.

Emissions per person: 3548 kgCO₂/person per annum.
 Energy per person: 11 822 MJ/person per annum.
 Area per person: 11 m²/person.



Green Power fraction: 0%.

Star Rating: 4.0 (182 kgCO₂/m²/yr)

Energy consumption: 1064 MJ/m²/yr (98%)
 Gas: 63 888 kgCO₂/m²/yr (15%)


Input: Requires building operational data - size in Net Lettable Area (NLA), location of the building, number of occupants, number of computers in regular use, number of hours per week that the building is occupied, and 12 months of billing data for all energy sources in the building. The user enters data via text inputs.

Output: Report on greenhouse rating (stars), normalised greenhouse emissions (kgCO₂/m²) and energy consumption (MJ/m²). The report shows what the star rating of the building means in terms of actual performance against the national benchmark.


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➤ **NSW Government Offices**
 Crown Property Portfolio c/- James Field
 84 Crown St.
 Wollongong NSW 2500

(3.5)
Certificate issued by:NSW - SEDAR**Rating type:**Whole building
Emissions (total):1839593 kgCO₂/yr
Emissions (normalised):201 kgCO₂/m²/yr
Total energy use:833 MJ/m²/yr (6% Green Power)
Rating period:30/4/2003 - 21/8/2004

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Endereço <http://www.athenasmi.ca/>



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Use browser's BACK and FORWARD buttons to move between pages without internal links

The ATHENA™ Sustainable Materials Institute

is finding answers to critical questions about the environmental impact of buildings and building products.



The not-for-profit Institute is a world-leading source of data, expertise and tools for designing buildings with the environment in mind.

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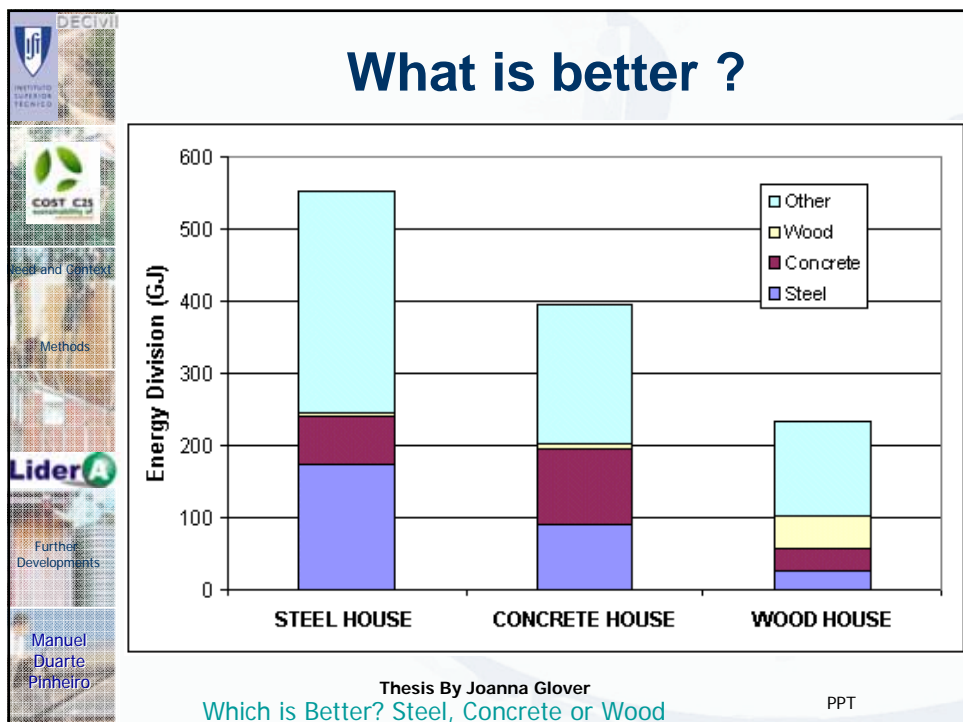
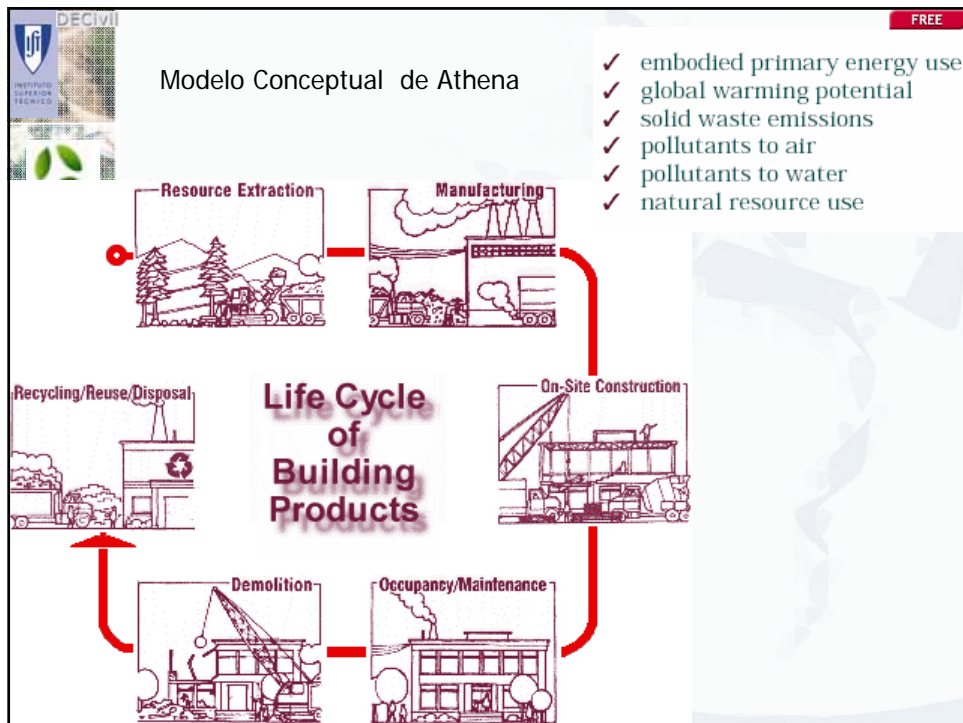
[LCA Database Project Newsletter](#)

[Newsletter Vol 4.1](#)

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Reports and Papers

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Research and Context



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Assess ?

Research and Context


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Further Developments

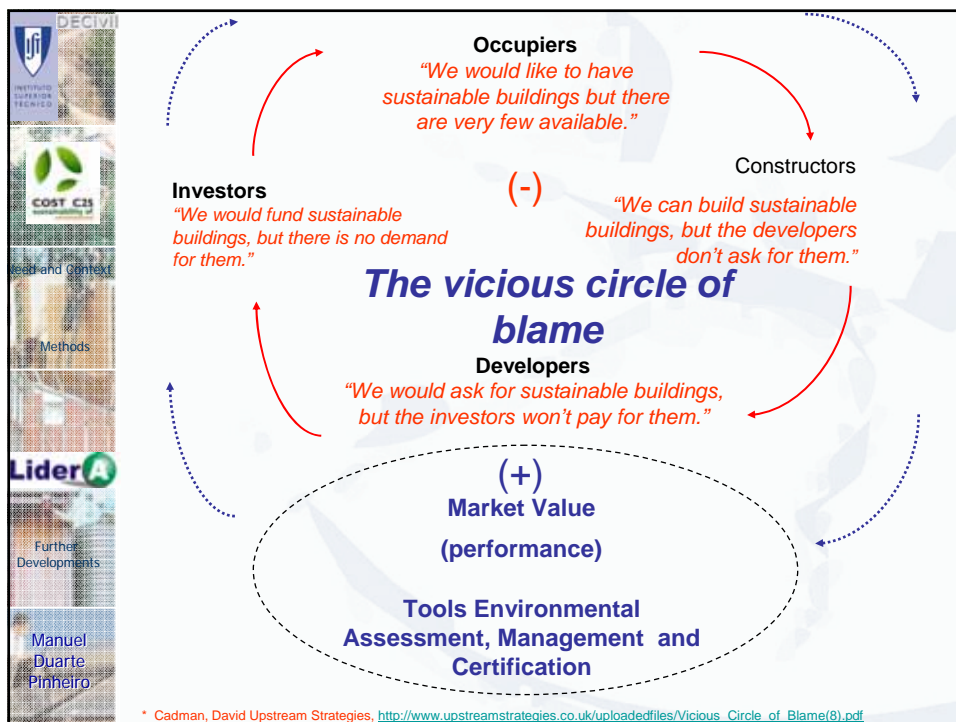
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Sustainable building



What is green buildings ?

http://www.architectstudio3d.org/AS3d/people_facehouse.html



Building Environmental Assessment Methods




Prof. Raymond Cole
(Tóquio, SB05)

GBTool

Sistemas de Avaliação Voluntários para Edifício

Building Environmental Assessment

- **BREEAM (UK)**
- **LEED (EUA)**
- **HQE (França)**
- Ecoprofile (Norway), Environmental Status (Sweden), Promise (Finland), EcoQuantum (Netherlands), NABERS (Australia), Green Leaf (Canada), TQ (Austria), CASBEE (Japan), ...
- **GB Tool (GB C), mais de 20 Países, ...**
- **LiderA (Portugal)**
- **Others**
 - Green Globe 21, ...
 - Ecological Labeling Tourist, ...
- **ISO Standards**
 - ISO 14040; ISO 14020; ISO 14001; ISO 14031 - ADA
 - **(ISO TC 59/SC3)**
 - CD1 Buildings and constructed assets – Sustainability in building – Framework for assessment of environmental performance of buildings





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Orientation and Certification





Guides

Assess

Certification





Platina
(52 – 69 pontos)




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Applied...

➤ **Use as local program**

➤ **BREEAM (Reino Unido); LEED (EUA); HQE (França); GB Tool, need adjustment to each country ...**

California Green Builder Program Sacramento, CA www.thecbi.org/gbip.asp	Santa Barbara County Planning and Development Santa Barbara County, CA www.countyofsb.org/plandev
Earth AdvantageTM Portland, OR www.earthadvantage.com	EcoBuild Memphis, TN www.mtga.com/SubView.php?key=about_ecobuild
EarthCraft House Atlanta, GA www.earthcrafthouse.com	WI Green Built Home Madison, WI www.greenbuilthome.org
Florida Green Building Coalition www.floridagreenbuilding.org	Sustainable Design Hennipin County, MN www.sustainabledesignguide.umn.edu
Green Building Program Frisco, TX www.ci.frisco.tx.us/development/development/greenbuilding/greenbuilding_home.htm	Tacoma Built Green Tacoma, Pierce County, WA www.umbapierce.com
Green Building Program Austin, TX www.ci.austin.tx.us/greenbuilder	Vermont Builds Greener Vermont www.bv-ei.org




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LiderA Approach

(Leadership by Environment)



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Manuel Duarte Pinheiro, Environmental Engineering,
Invited professor at the Department of Civil
Engineering and Architecture, in Instituto Superior
Técnico



2000/2003

Applied and Development



Aplicação Nacional

Versão 2001



Testes de Aplicação Nível Nacional




Aplicação





2004/2006

Adjust the system to Portuguese reality




Certification test cases

LiderA®

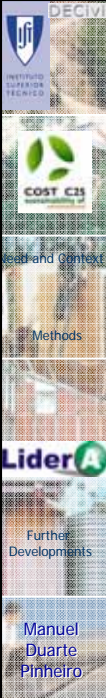
2007/...

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LiderA

- Voluntary Assessment Environmental System to Buildings; (base to Environmental Management System)
- Environmental could be a leadership factor to sustainable , in portuguese "*liderar pelo Ambiente*;
- Promote integrated environmental performance improvement
- **LiderA**® (Portuguese Trademark)
- *The system is base of scientific works about sustainability in building and built environments, performed since 2000 and which lead to the prototype V1.01 publication in 2005, and actual version V1.02.*



LiderA (Liderar pelo Ambiente)

Scope:


- Environment,
 - Reduce approach to Social (Health and Comfort) and economics (viable measures in performance criteria)



Object:

- Building (s) and near space ()
- Multi uses (Homes, Offices, Services, Tourism, ...)
- Local (climatic) conditions
- Voluntary Assessment System

Life Cycle:


- The assessment could happen in any of phases (Plan, Project, Construction, Operation, Refurbishing/Demolition)



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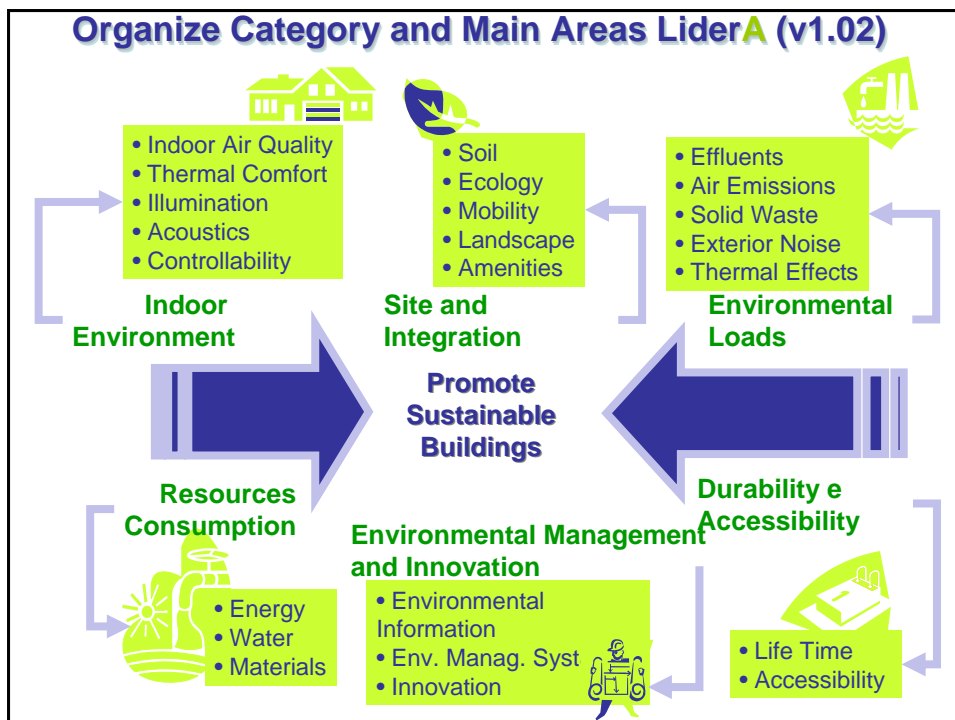
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Choosing Criteria...

➤ Environmental Aspect and Impact Assessment (EIS and ISO 14001)

MACRO ACTIVIDADES	ACTIVIDADES	ASPECTO AMBIENTAL	IMPACTOS ASOCIADOS	Tempo: Atenuação (Duração da permanência do Impacto)		Reversibilidade	
				Valor	Notas	Valor	Notas
	Consumo de energia	Liberação de efluentes atmosféricos	Não produção de chuva ácida, perda de biodiversidade, destruição de ecossistemas e monumentos, alteração de água superficial, eutrofização, alterações no sistema respiratório.	10	menor de 1 ano (permanente até 100)	100	uma vez emitido é impossível voltar atrás, no entanto é possível implementar medidas com vista à sua diminuição
			CO2 afecta o metabolismo, emite gases para humanos e provoca alterações no sistema nervoso central	10	Tempo de permanência que alguns organismos aquáticos ficam na atmosfera, emitidos durante fogos florestais, Compostos	100	uma vez emitido é impossível voltar atrás, no entanto é possível implementar medidas com vista à sua diminuição
				10	Permanência (anos): CH4 12 - CO2 104 C2H6 10 - CH4 125 CO 125 - NO 100 CO2 12 - Acetona 100	100	uma vez emitido é impossível voltar atrás, no entanto é possível implementar medidas com vista à sua diminuição
		Aumento da pressão sobre a rede de distribuição	10	Infra-estruturas devem ser reforçadas (tubo de concreto/cabo de aço, 10 anos)	100	uma vez emitido o impacto não se pode voltar, controla problemas implementando medidas de manutenção como a substituição de materiais	


➤ Environmental Aspects and mainly criteria in other approach's (importance and weighting)



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Organizing Approach



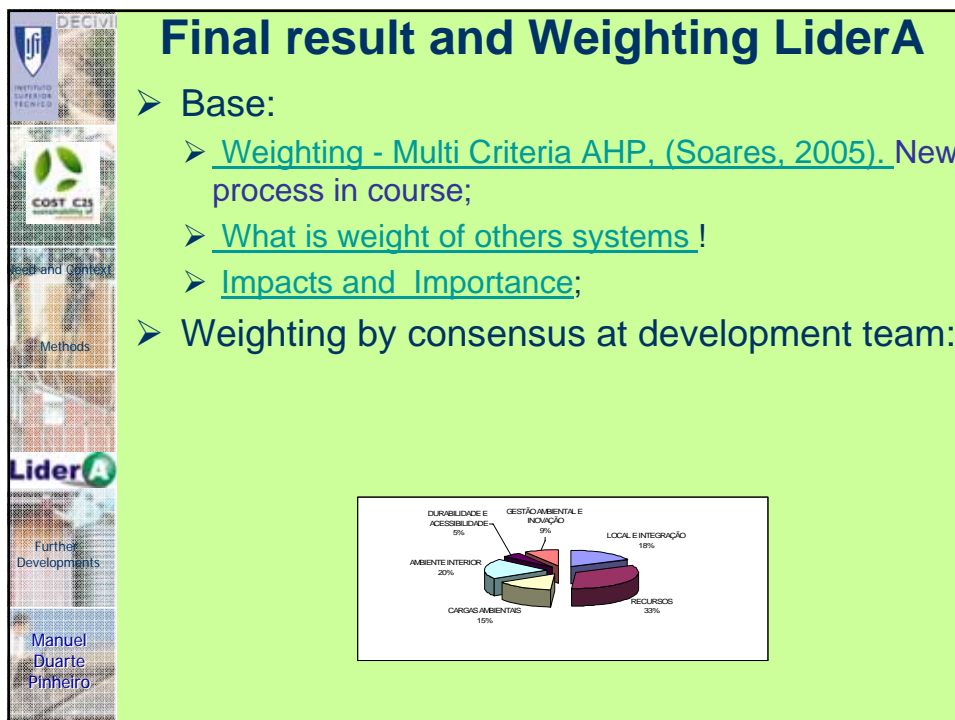
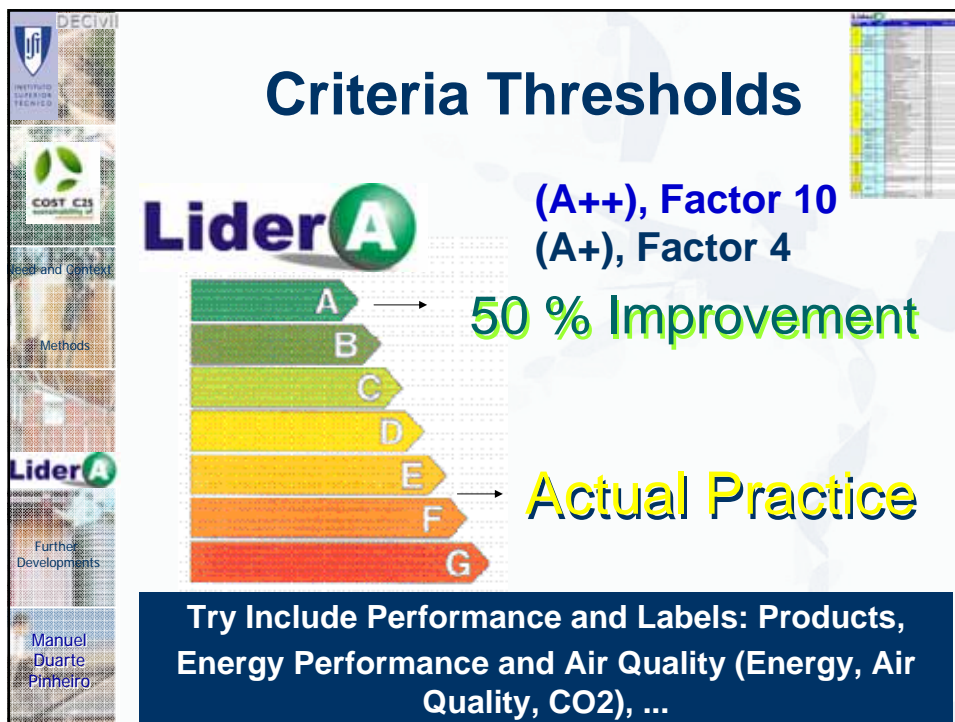
- Principles (6)
- Area (22) and base Criteria (50)
- Complementar optional
- ...



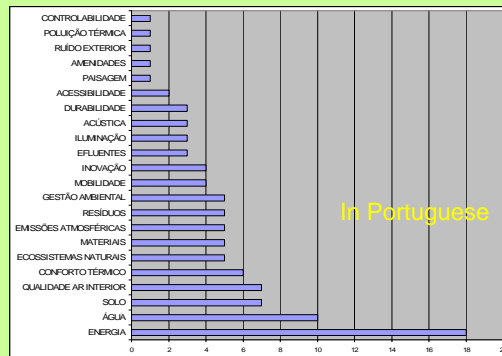
LiderA v1.01		Building		Data		
Pre-evaluation tool for producing a sustainable building						
CATEGORY	AREA	Pre-R	Nº C	CRITERIA		
SITE & INTEGRATION	SITE	Y	C1	Site selection - plan context		
			C2	Building Footprint		
			C3	Soil ecological functions		
			C4	Natural areas		
			C5	Ecological integration		
	LANDSCAPE	Y	C6	Local integration		
			C7	Local amenities and integration		
	AMENITIES	Y	C8	Low impact mobility		
			C9	Public transport access		
			C10	Passive Design Performance		
6 CRITERIA	MINIPLY					
10.0 %						
RESOURCES	ENERGY	Y	C11	Electricity consumption		
			C12	Electricity from renewable sources		
			C13	Energy from other sources		
			C14	Energy from renewable sources		
			C15	Equipment efficiency		
			C16	Domestic water use reduction		
			C17	External water use reduction		
			C18	Consumption and losses control		
			C19	Rainwater collection		
			C20	Local water management		
	WATER	Y	C21	Low materials intensity		
			C22	Local materials		
			C23	Recycled and easily renewable materials		
			C24	Certified and low emitting materials		
	MATERIALS	Y	C25	Wastewater production		
			C26	Wastewater treatment		
			C27	Wastewater recycling		
			C28	CO ₂ emissions		
11 CRITERIA	ENVIRONMENTAL & CLIMATE					
20.0 %						
INDOOR ENVIRONMENT	WASTEWATER	Y	C29	SO ₂ , NO _x and particulate emissions		
			C30	OFC emissions		
			C31	Waste production		
	ATMOSPHERIC EMISSIONS	Y	C32	Household waste management		
			C33	Waste recycling		
			C34	Hazardous waste management		
	WASTE	Y	C35	Noise external exposure reduction		
			C36	Heat island effect		
	11 CRITERIA	EXTERNAL NOISE				
	20.0 %					
	INDOOR ENVIRONMENT	THERMAL EFFECTS	Y	C37	Ventilation and natural contribution	
				C38	UVC emissions	
				C39	Micro-contaminants prevention	
		THERMAL COMFORT	Y	C40	Thermal and humidity comfort	
				C41	Lighting levels	
				C42	Natural lighting	
		LIGHTING	Y	C43	Acoustic insulation levels	
				C44	Conformability	
9 CRITERIA		ACOUSTIC				
10.0 %						
DURABILITY & ACCESSIBILITY		Y	C45	Durability		
			C46	Durability (Life time)		
4 CRITERIA		DURABILITY				
0.0 %						
ENVIRONMENTAL MANAGEMENT & INNOVATION		Y	C47	Accessibility to disabled people		
			C48	Accessibility and relation with the community		
2 CRITERIA		ACCESSIBILITY				
0.0 %						
ENVIRONMENTAL MANAGEMENT	Y	C49	Environmental information			
		C50	Environmental management system			
2 CRITERIA	ENVIRONMENTAL MANAGEMENT					
0.0 %						
BIOCLIMATE	Y	C51	Innovation in practices, solutions and integrations			
		C52	Innovation in practices, solutions and integrations			
2 CRITERIA	BIOCLIMATE					
0.0 %						

www.lidera.info

www.lidera.info



Exº Area Weighting LiderA V1.02



In Portuguese

LiderA Application System

- **Documents**
 - LiderA Guide - Technical Specification (v1.02, 2006)
 - Verification List
 - Thresholds (Performance)
 - Management and Control System
- **Stakeholders Role**
 - **Development Team**
 - **Verifier (Third Part)**
 - **Assessor**
 - Course, Exam, ethical / deontological Co
 - **Promoters**
 - **Others Stakeholders**



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Cases

Test cases, in the residential and tourist versions, were evaluated and allowed to test and check the system while it was being developed.

These were evaluated by LiderA 1.02 version and are :

- [Torre Verde \(Lisbon\)](#)
- [Ponte da Pedra \(Matosinhos\)](#)
- [Casa Oásis \(Faro\)](#)
- [Parque Oriente \(Lisbon\)](#)
- [Hotel Jardim Atlântico \(Calheta\)](#)



DECIVIL

1993

89 Alameda

8 Bump

Local e Integração

Recursos

Cargas Ambientais

Ambiente Interior

Gestão Ambiental e Inovação

Hotel Jardim Atlântico, Madeira

4	Amenidades	
C7	Valorização das amenidades locais	
6	Energia	
C11	Redução do consumo de electricidade	
C15	Eficiência dos equipamentos	
7	Água	
C16	Redução do consumo de água	
9	Efluentes	
C26	Tipo de tratamento das águas residuais	
C27	Caudal de reutilização de águas usadas	
10	Resíduos	
C31	Redução da produção de resíduos	
C33	Percentagem de resíduos valorizados	
14	Qualidade Ar Interior	
C38	Prevenção de micro contaminações	
15	Conforto Térmico	
C39	Nível de conforto térmico	
21	Gestão Ambiental	
C48	Informação ambiental	
C49	Sistema de gestão ambiental	















1998
7 200 m²
12 pisos
141 Fogos

Torre Verde, Lisboa

Local e Integração

	1	Solo
	C1	Seleção do local
	4	Amenidades
	C7	Valorização das amenidades locais

Recursos

	6	Energia
	C10	Desempenho energético passivo
	C11	Redução do consumo de electricidade
	C14	Uso de outras formas de energia renovável

Ambiente Interior

	14	Qualidade Ar Interior
	C36	Ventilação e contributo natural
	C38	Prevenção de micro contaminações
	15	Conforto Térmico
	C39	Nível de conforto térmico
	16	Luz Natural
	C40	Níveis de iluminação
	C41	Iluminação natural

Gestão Ambiental e Inovação

	21	Gestão Ambiental
	C48	Informação ambiental
	C49	Sistema de gestão ambiental








2002
240 m²

Casa Oásis, Faro

Local e Integração

	1	Solo
	C3	Assegurar as funções ecológicas do solo
	3	Paisagem
	C5	Integração e valorização local

Recursos

	6	Energia
	C10	Desempenho energético passivo
	C11	Redução do consumo de electricidade
	C15	Eficiência dos equipamentos

Cargas Ambientais

	13	Efeitos Térmicos
	C35	Diminuição do efeito de ilha de calor

Ambiente Interior

	14	Qualidade Ar Interior
	C36	Ventilação e contributo natural
	C38	Prevenção de micro contaminações
	15	Conforto Térmico
	C39	Nível de conforto térmico
	16	Luz Natural
	C41	Iluminação natural
	17	Acústica
	C42	Isolamento acústico/Níveis sonoros
	18	Controlabilidade
	C43	Capacidade de controlo







2006
14 852 m²
101 Fogos

Ponte da Pedra, Matosinhos

Local e Integração

	1 Solo	
	C1	Seleção do local

Recursos

	6 Energia	
	C10	Desempenho energético passivo
	C11	Redução do consumo de electricidade
	C14	Uso de outras energias renováveis
	7 Água	
	C16	Redução do consumo de água
	C17	Redução de água noutros espaços
	C19	Utilização de águas pluviais
	8 Materiais	
	C22	Materiais locais

Ambiente Interior

	14 Qualidade Ar Interior	
	C36	Ventilação e contributo natural
	C39	Nível de conforto térmico
	16 Luz Natural	
	C41	Iluminação natural
	17 Acústica	
	C42	Isolamento acústico/Níveis sonoros










COST C25
Sustainability 2020



Methods

Lider A

Further Developments


Manuel Duarte Pinheiro

Further Development

Lead and Context


Methods




Further Developments

Manuel Duarte Pinheiro

Further Development



- **Threshold Levels**
- **Economic Costs**
- **Precise Technical Calculations Models**
- **Greater contribution from LCA Studies**





Holistic Approach



Use local aspects

Resources – Energy and water

Interior Environment (Comfort)

Environmental information (Management)



Applied in Portugal, voluntary base, market approach



Further Information

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