

LiDe – Porto

June 30, 2014



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ERASMUS INTENSIVE PROGRAMME
2013 - 2014

Influence of lighting in green building certification

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Why do we need environmental rating systems?



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Rating and certification systems:

- help **define** green buildings in the market.
- inform how environmentally sound a building is.
- provide clarity to what extent green components have been incorporated.
- Inform on which sustainable principles and practices have been employed.

Many different rating systems exist, and each has pros and cons depending on the specifics of your building.



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Rating a green building:

- informs tenants and the public about the environmental benefits of a property.
- discloses the additional innovation and effort the owner has invested to achieve a high performance building



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Rating a green building:

- can reduce implied risks. Since rating systems often require independent third-party testing of the various elements, there is less risk that the systems will not perform as predicted.
- there is less risk that the project has been “green washed” —or marketed to create the perception that a property is green, when in fact no real effort or expense has been invested to achieve that goal.



What is the LEED?

LEADERSHIP in
ENERGY and
ENVIRONMENTAL
DESIGN

A leading-edge
system for
certifying
DESIGN,
CONSTRUCTION,
& OPERATIONS
of the greenest
buildings in the
world.



Consensus-Based Standards

USGBC has four levels of LEED:



Green Buildings worldwide are certified with a voluntary, consensus-based rating system.

What is BREEAM?

BRE Environmental Assessment Method.

Benchmarks and checklists of performance

Positive credits - motivational and practical

Developed in partnership with commerce and industry

Progressively evolving and improving

- BREEAM is the world's longest established and most widely used environmental assessment method for buildings.
- It sets the standards for best practice in sustainable development and demonstrates a level of achievement.
- It was created by BRE (Building Research Establishment Limited) in 1990 in the UK.
- In the UK 65,000 buildings have been certified to date and a further 270,000 are currently registered for assessment.
- ISO certified

BREEAM – Buildings Types

Code for Sustainable Homes (used to be EcoHomes)

BREEAM for Offices

BREEAM for Schools (used to be SEAM)

BREEAM for Healthcare (used to be NEAT)

BREEAM for Retail

BREEAM Industrial

BREEAM Bespoke

BREEAM International

Note: sub categories exist also within BREEAM bespoke and BREEAM International (Gulf, Toyota, Europe, Courts, Prisons, Multiresidential etc.)

RATING SYSTEM



Breem

Leed

Pass 30-44 percentage

Good 45-54 percentage

Very Good 55-69 percentage

Excellent 70-84 percentage

Outstanding 85-100 percentage



Certified 40-49 points

Silver 50-59 points

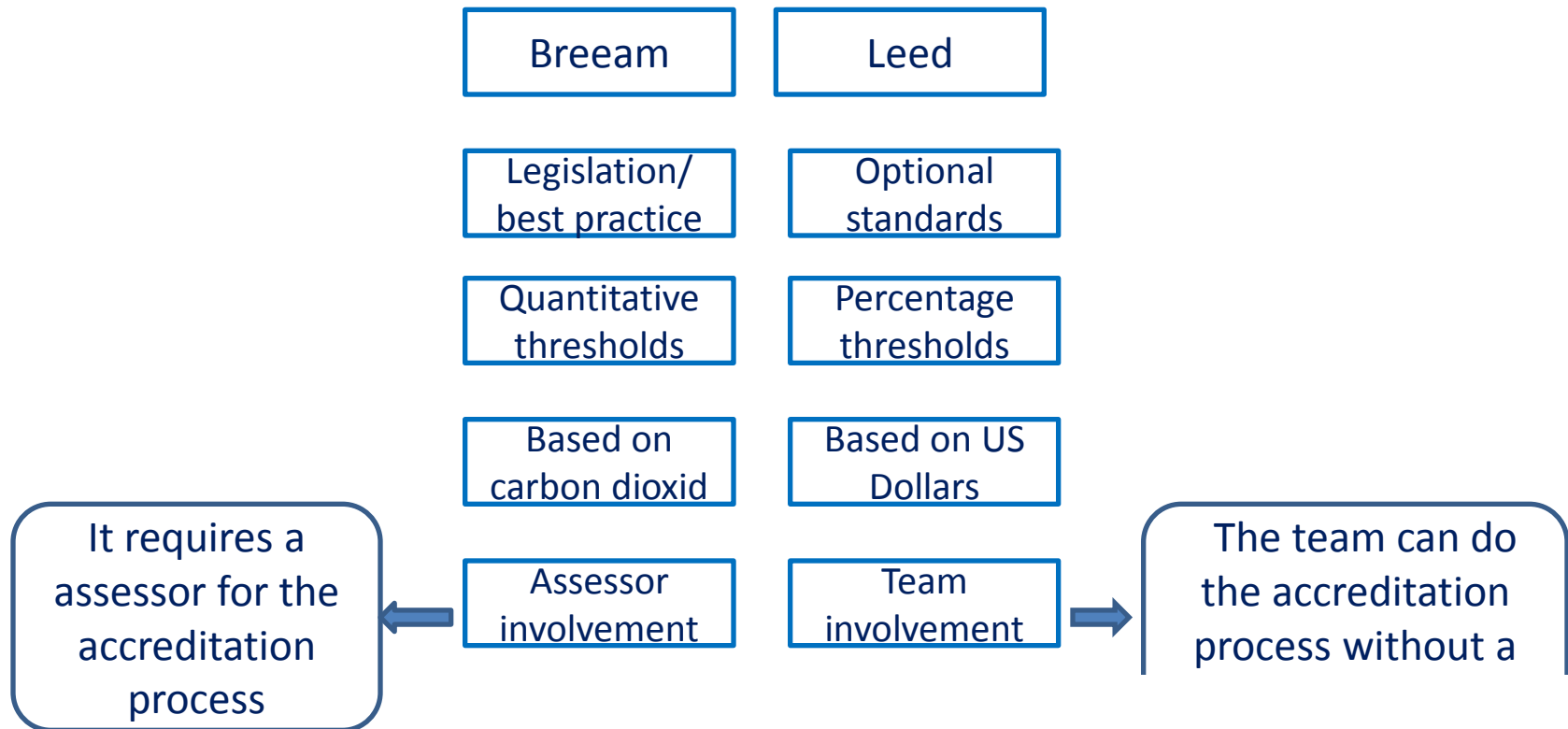
Gold 60-79 points

Platinum 80-100 points

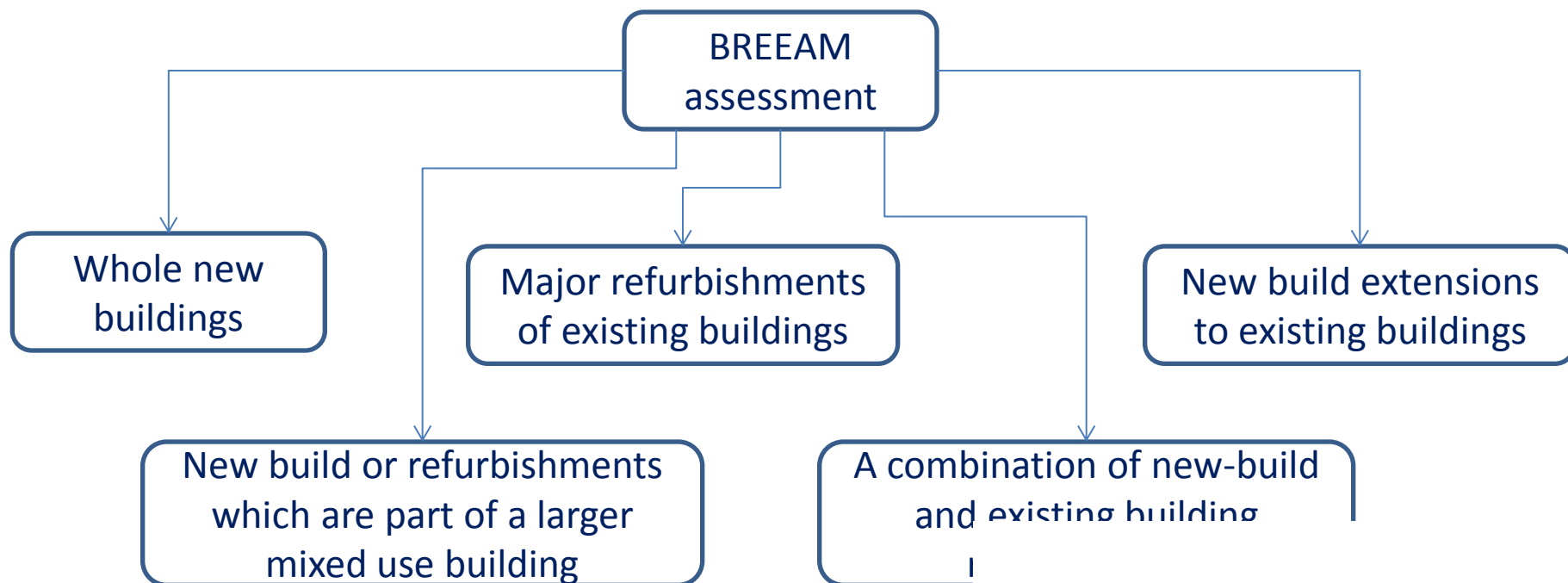


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The main differences between LEED and BREEAM

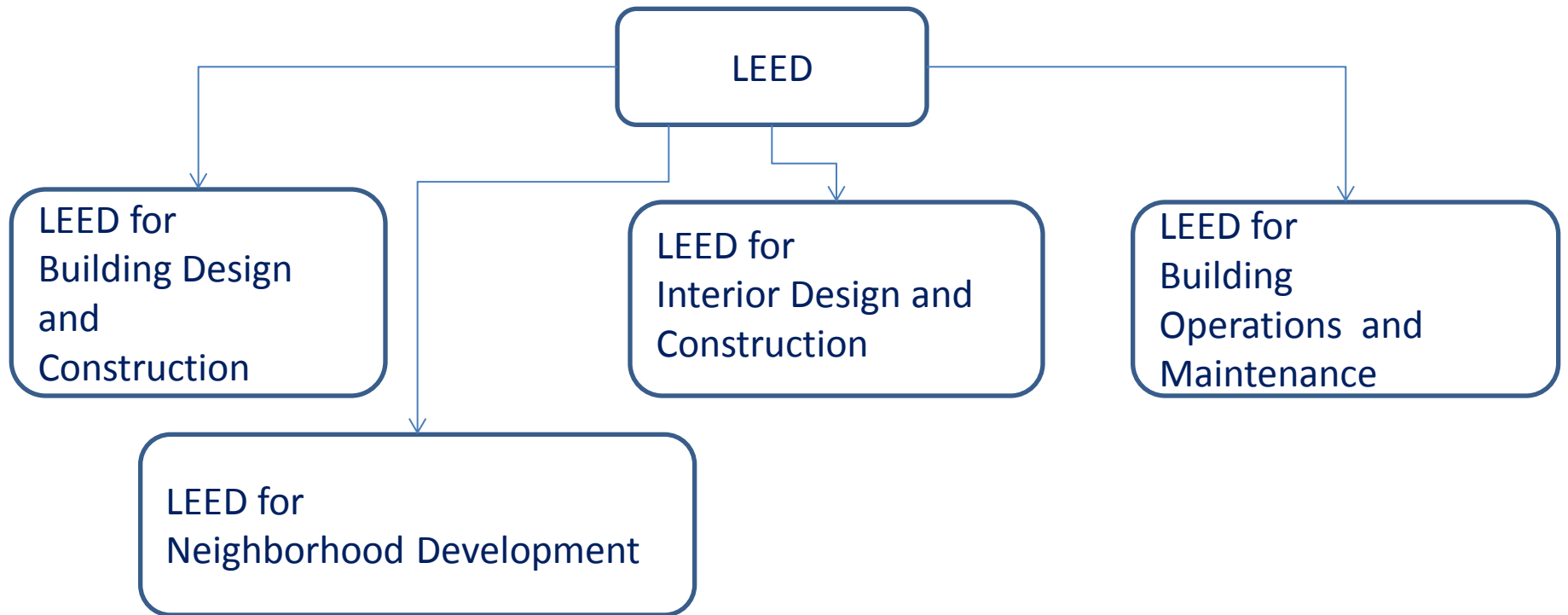


- A BREEAM assessment can be carried out for the following types of building project only:





- A LEED assessment can be carried out for the following types of building project only:



Breem In Use

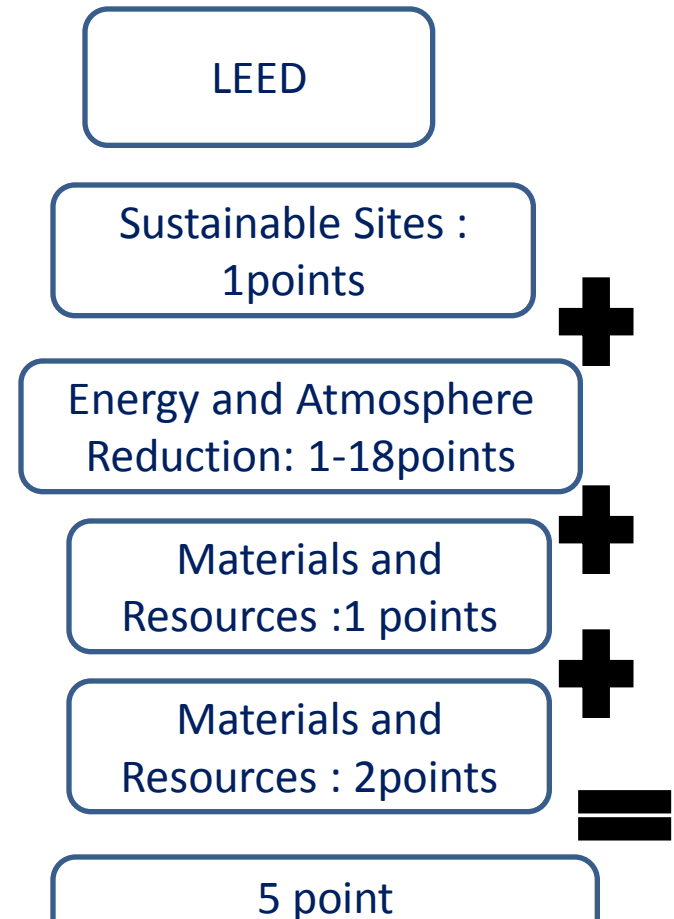
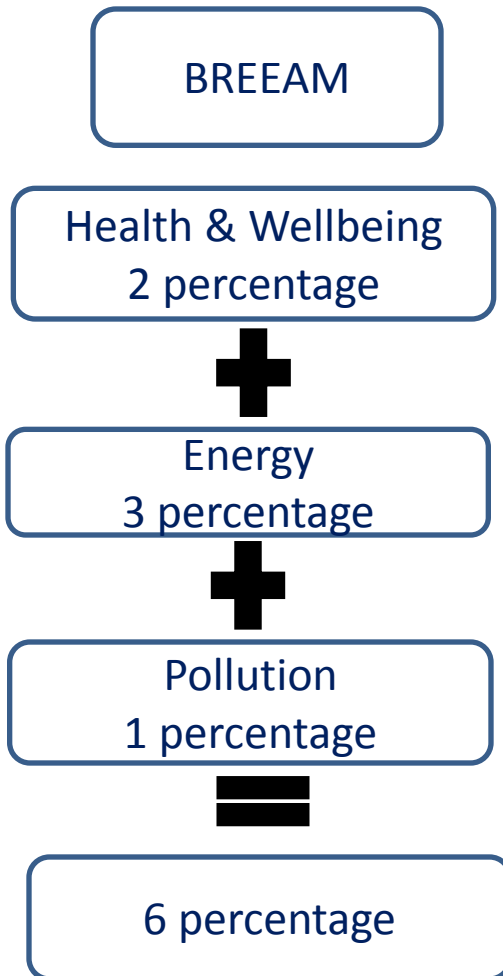


- Certifies the building management not the building
- Breeam In Use does not mean green building
- Bream In Use is a self assessment
- Help improve the building management during operation
- Evaluates three levels
 - Assets
 - Building management
 - Facility Operations (for tenants)



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Points obtained exclusively for the lighting system



Points obtained for the lighting system



- The importance of the lighting system in the building certification does not stop at those 6 or 5 points, those are points that are influenced exclusively by the lighting system.
- Lighting system characteristics that influence other points of these two schemes:
 - the place of manufacture,
 - the material used,
 - the life cycle,
the possibility of recycling,
 - etc.



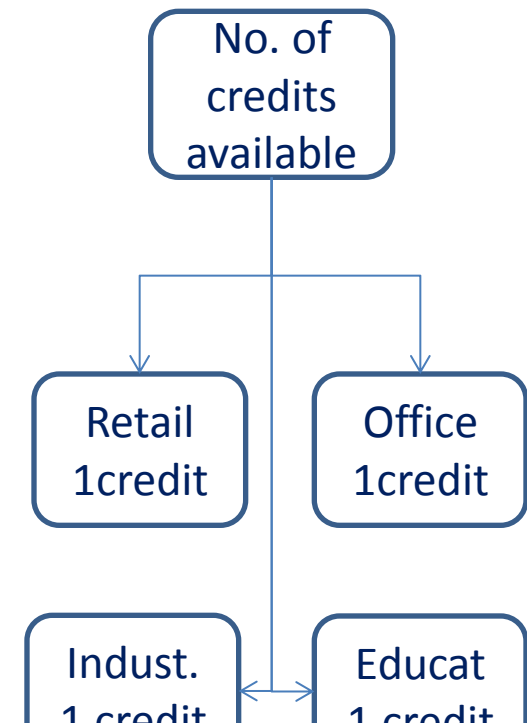
Breem2013:Health & Wellbeing

Hea1-1 credit



According to *HEA.1-Visual comfort*

- **Pre-requisite**
 - All fluorescent and compact fluorescent lamps are fitted with high frequency ballasts or the building is exclusively fitted with LED lighting.
- **One credit**
 - Internal and external lighting illuminance (lux) levels must be specified in accordance with national best practice lighting guides
 - The uniformity of illuminance due to electric lighting is as per the recommendation in the approved local standard.



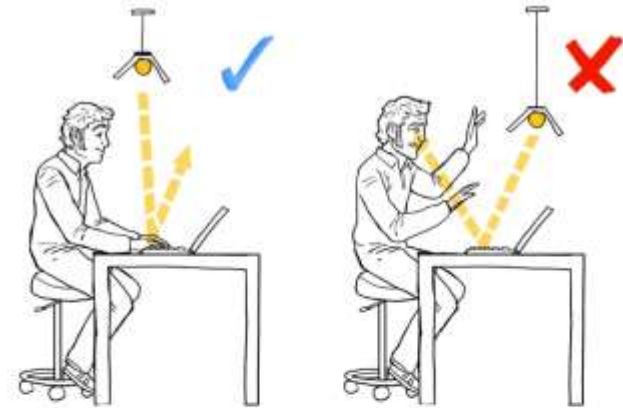
Breem2013:Health & Wellbeing

Hea1-1 credit



Additions to the previous slide

- For areas where computer screens are regularly used, confirmation is required that the lighting has been designed to limit the potential for glare
- Lighting is zoned to allow separate occupant control of the following areas (where applicable):
 - In office areas, zones of no more than four workplaces
 - Workstations adjacent to windows/atria and other building areas separately zoned and controlled
 - Seminar and lecture rooms: zoned for presentation and audience areas
 - Library spaces: separate zoning of stacks, reading and counter areas.



Breeam2013:Health & Wellbeing

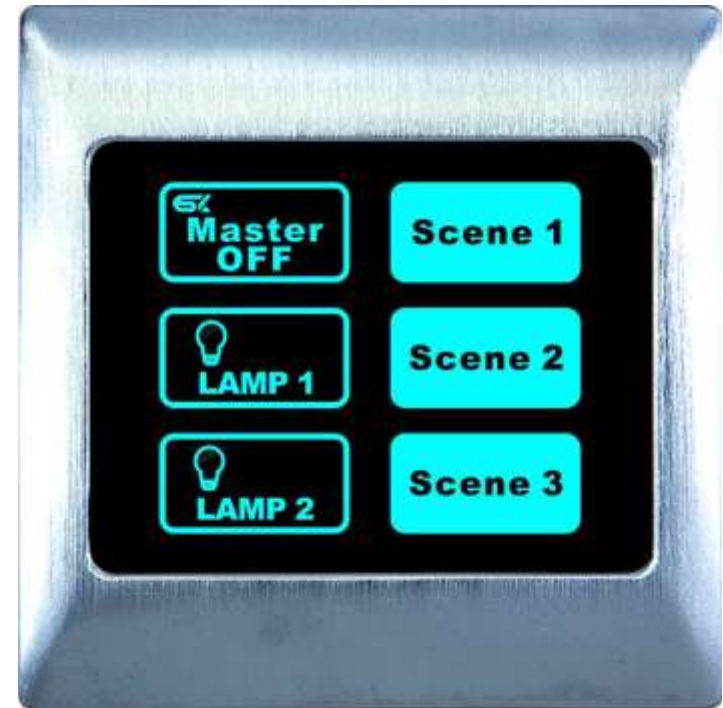
Hea1-1 credit



Additions to the previous slide

○ Lighting must be zoned to allow separate occupant control of the following areas (where applicable):

- In office areas, zones of no more than four workplaces
- Workstations adjacent to windows/atria and other building areas separately zoned and controlled
- Seminar and lecture rooms: zoned for presentation and audience areas
- Library spaces: separate zoning of stacks, reading and counter areas.
- Where occupancy/workstation layout is not known, lighting control can be zoned on the basis of 40m² grids.



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Breeam2013:Health & Wellbeing

Hea 06 -1 credit

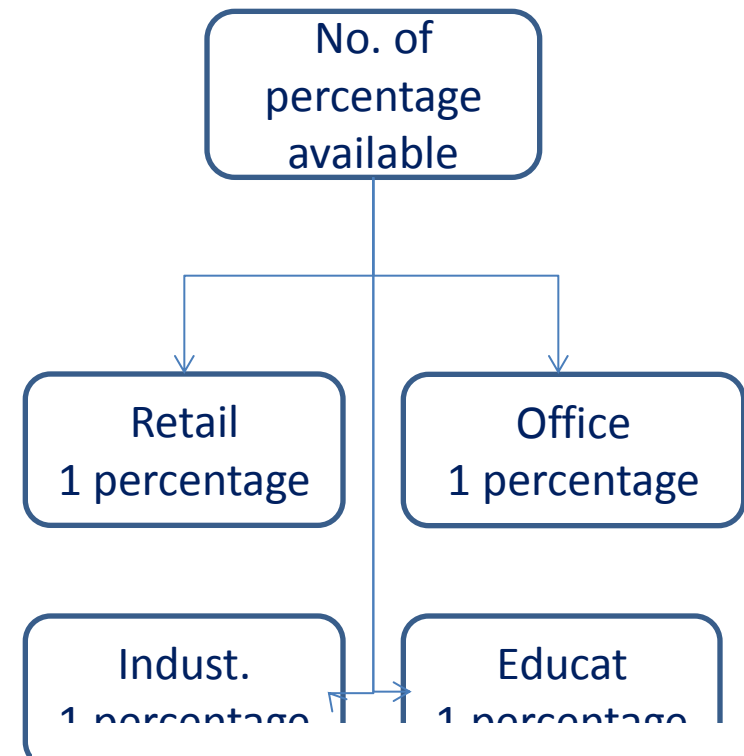


According to *HEA.6*- Safe access:

- The lighting for access roads, pedestrian areas, footpaths and cycle lanes is compliant with the national best practise road lighting guide

The purpose is:

- To recognise and encourage effective design measures that promote low risk, safe access to and from the building.



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Breeam2013:Energy

ENE 02 -2 credits

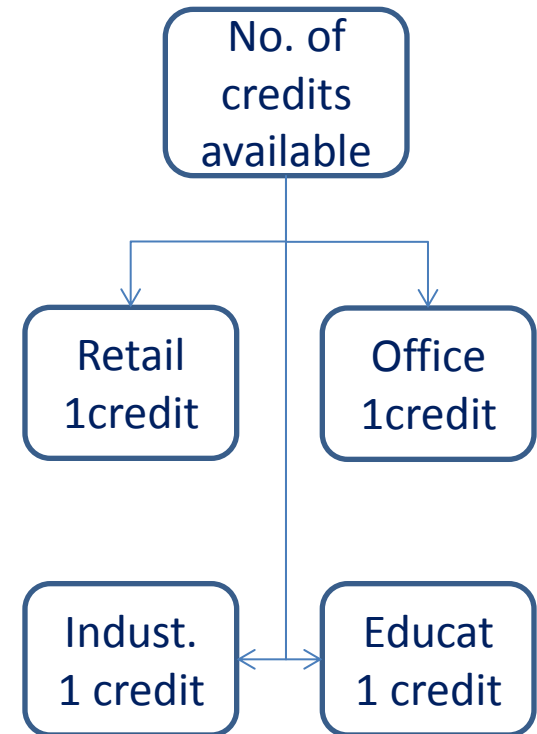


According to *ENE.2*-Energy monitoring:

- Separate accessible energy sub-meters, labelled with the end use of the consumed energy that is being sub-metered, must be provided for the lighting systems.

OR

- Where a BMS (Building Management System) has been installed, with individual monitoring and outputs for the lighting systems.



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Breem2013:Energy

ENE 02 -2 credits

Additions to the previous slide

- Due to traditional distribution methods, it can be difficult to cost-effectively separate lighting and small power. It is acceptable, within a single floor, for lighting and small power to be combined for metering purposes, provided that sub-metering is provided for each floor plate.

The purpose is:

- To recognise and encourage the installation of energy sub-metering



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Breeam2013:Energy

ENE 03 -1credit



According to ENE.3-External Lighting:

- All external fittings, where provided, within the Construction zone meet or exceed the lighting requirements as given in Table

External lighting location	Light fittings measured in lamp lumens/circuit Watt, when:		LED luminaires where the lamp is integral to the fitting measured in luminaire lumens/circuit Watt, when:	
	Colour rendering index (Ra) ≥ 60	Colour rendering index (Ra) < 60	Colour rendering index (Ra) ≥ 60	Colour rendering index (Ra) < 60
Building, access ways, pathways	50	60	40	50
Residential balconies, terraces	50	-	40	50
Car parking, associated roads, floodlighting	70	80	55	60
	Lamp wattage $\geq 25W$	Lamp wattage $< 25W$	Lamp wattage \geq	Lamp wattage $<$



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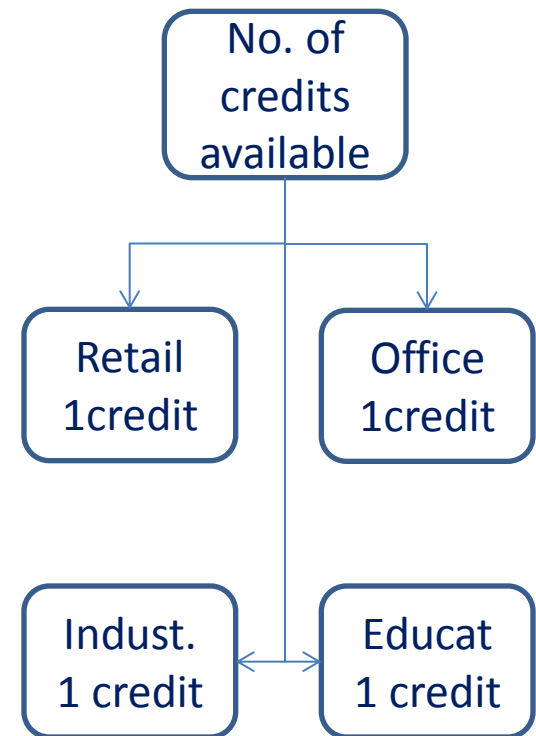
Breeam2013:Energy

ENE 03 -1credit



Additions to the previous slide

- External light fittings are controlled through a Time switch, or Daylight sensor, to prevent operation during daylight hours. Daylight sensor override on a manually switched lighting circuit is acceptable.



BREEAM2013:Pollution

POL04 - 1credit



According to POL.4- Reduction of night time light :

- The external lighting must be concentrated in the appropriate areas and that upward lighting is minimised, reducing unnecessary light pollution, energy consumption and nuisance to neighbouring properties.
- External lighting can be automatically switched off between 23:00hrs and 06:00hrs. This can be achieved by providing a timer for all external lighting set to the appropriate hours.

Recommendations for the uniformity of illuminance from Breeam Pol7, Table 12.4

Type of illumination	Illuminated Area	Uniformity of illuminance
External	Over 1.5m ²	10:1
External	Up to 1.5m ²	6:1
Internal	Above and between the light sources	1.5:1



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LEED Sustainable Sites



No. of credits
available
:1credit

According to SSc8: Light Pollution Reduction:

- Interior Lighting

All non-emergency built-in lighting with direct line of sight to any envelope opening must be controlled to automatically turn off after hours

Lights have to be off for at least 50% of after hours time

Implement a maintenance program

- Exterior Lighting

Option 1: shield fixture greater than 50 watts from the night sky

Option 2: Measure the exterior lighting to show that exterior lighting does not increase site perimeter light levels by more than 20%



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LEED Energy and Atmosphere



Required

- According to EAp1: Energy Efficiency Best Management Practices the following documents which must be delivered :
 - Building Operating Plan
 - Systems Narrative
 - Sequence of Operations
 - Preventive Maintenance Plan
 - Summary Report of an ASHRAE Level I Walkthrough

must include information about the lighting system, so the designer must be careful when his choosing the lighting solutions, the lighting quality and the system parameters can influence getting this prerequisite.



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LEED Energy and Atmosphere



No. of credits
available :1-18 credits

According to EAc1: Optimize Energy Performance Practices:

- Building owners can reduce operating costs by optimizing energy performance, changing lighting solutions is encouraged by LEED EBOM-2009

The team must track a minimum 12 months of data for all energy consumption, a significant reduction in energy consumption increases the number of points earned by the building.

PERCENTILE LEVEL ABOVE THE NATIONAL MEDIAN (for buildings not eligible for ENERGY STAR energy performance rating)	POINTS
21	1
23	2
24	3
25	4
26	5
27	6
28	7
29	8
30	9
31	10
32	11
33	12
35	13
37	14
39	15
41	16
43	17



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LEED Materials and Resources



No. of credits
available :1 credit

According to MRc4: Sustainable Purchasing—Reduced Mercury in Lamps :

- The credit encourages project teams to develop and implement guidelines for lamp purchases, ultimately reducing the amount of mercury used for lighting below certain limits
- If is an existing building, first step is to inventory all interior and exterior lamps to document the manufacturer, model, and technical specifications, including mercury content



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LEED Indoor Environmental Quality



No. of credits
available :1 credit

According to IEQc2.2: Controllability of Systems—Lighting

- The requirements of this credit—providing lighting controls for at least 50% of occupants
- In multi-occupant workspaces the credit requires that controls are "adjustable to suit group activities and allow flexibility for different uses
- In special-use spaces—such as museums, visitor centers, or fitness clubs—where visitors have limited access to lighting controls, meet the credit requirement by specifying that building staff will be available to adjust lighting conditions as necessary.



**GREEN BUILDING
PROFESSIONAL**
Year-Round Education Program

LEED Indoor Environmental Quality



No. of credits
available :1 credit

According to IEQpc22: Interior lighting - quality

- This pilot credit is proposed to expand on the current lighting requirements, in order to address the quality of the lighting in a space. Quality criteria focus on illuminance and reflectance to attempt to maximize occupant comfort and productivity.



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Case Study1



Office building
City: Cluj-Napoca
In progress of certification
BREEAM Very Good

Case Study 2



Office building
City :Cluj-Napoca
In progress of certification
LEED EBOM Gold



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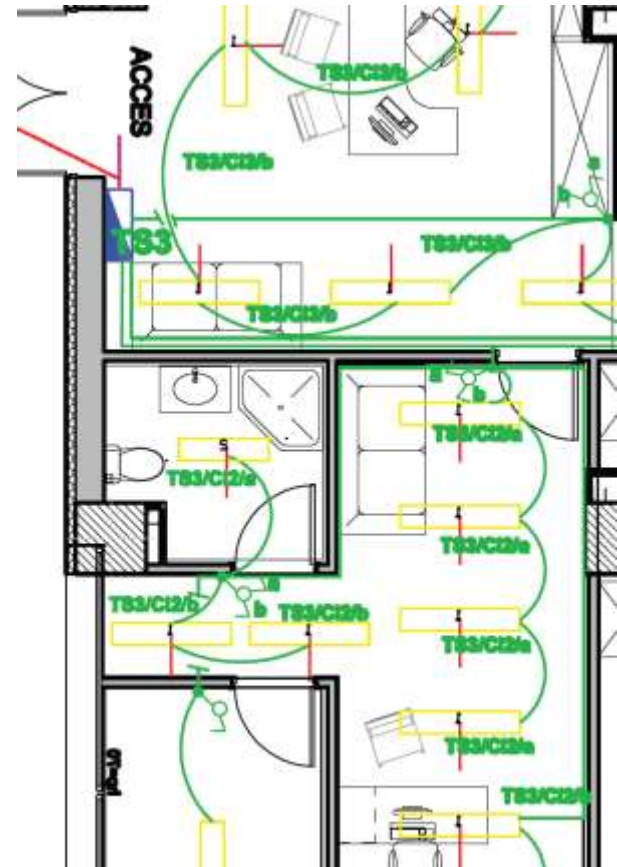
Case Study1-Breeam

- ***.HEA.5-Internal and external lighting levels***
 - The lighting levels have been calculated, according to the values indicated in normative, as follows: Office areas: 500lx,Corridors: 200lx, Sanitary groups: 200lx etc.
- ***HEA.4-High frequency lighting:***
 - The indoor lighting installation is made using lighting devices equipped with fluorescent lamps fitted with high frequency ballasts.
 - Outdoor lighting is achieved with LEDs
- ***POL.7- Reduction of Night Time Light Pollution***
 - Exterior lighting during the night (23a.m-5a.m) is focused only on the Sidewalk and access areas for safety



Case Study1-Breem

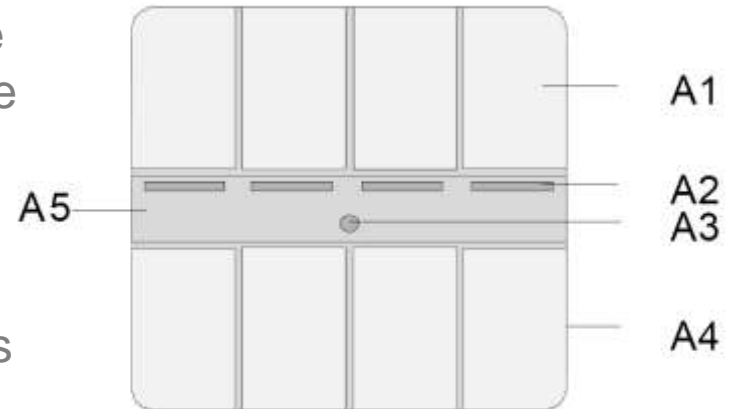
- **HEA.6-Lighting zones and controls**
 - Each space is equipped with a switch.
 - Where there are several work spaces , two switches were installed, the space is divided into several lighting areas, depending on the distance from the window
- **ENE.2-Sub-metering of Substantial Energy Uses**
 - 6 accessible energy sub-meters were installed in the building:2 for the technical spaces, 4 for the rest of the electrical system



Case Study2-LEED

- **IEQpc22: Interior lighting – quality**
 - The intelligent control system of the building turns on the lights according to the level of natural light and the presence of people in the offices, on the hallways, stairs, restrooms. The light is adjustable within each space
- **MRc4: Sustainable Purchasing—Reduced Mercury in Lamps :**
 - More than 30% of the lighting in the building is made by LEDs, the rest is achieved with fluorescent lamps fitted with high frequency ballasts.
 - The team has implemented a plan to replacing all fluorescent lamps with LEDs in the next years (this also influences EAc1: Optimize Energy Performance Practices)

In order to switch between manual and automatic mode for the lights



The automatic adjustment of the light intensity a light sensor



Case Study2-LEED

- **IEQc2.2: Controllability of Systems— Lighting**
 - It provides lighting controls for at least 75% of occupants
 - Automatic adjustment of the light intensity according to natural light received from outside
 - The lighting can be set from a distance using the BMS
- **SSc8: Light Pollution Reduction**
 - During the night only emergency lighting on stairs and hallway stays on
 - Exterior lighting does not increase site perimeter light levels by more than 20%



LCA



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Environmental Product Declaration

European Core EPD



Institute Construction
and Environment e.V.



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Material composition

Materials	weight [kg]	weight [%]	Materials	weight [kg]	weight [%]
Steel	3,67E-02	2,98	Nickel	9,69E-07	0,00
Epoxy resin	2,00E-03	0,16	PC	3,41E-01	27,74
Silicon dioxide (SiO ₂)	2,00E-03	0,16	PE	1,58E-02	1,28
Silicon	5,22E-05	0,00	Copper	1,23E-01	9,96
Tin	4,67E-03	0,38	Ferrites	4,65E-02	3,78
Aluminum and alloys	6,19E-01	50,29	EPDM	2,16E-03	0,18
Aluminum Oxide (Al ₂ O ₃)	1,31E-03	0,11	Silicone	2,81E-04	0,02
Copper alloys	9,37E-04	0,08	Colophony	3,21E-05	0,00
Tetrabromobisphenol A (TBBA)	8,00E-06	0,00	TPE	3,51E-02	2,86
Tin in alloy	3,06E-04	0,02	Not Considered	0,00E+00	0,00
Gold	1,87E-06	0,00	Total Weight		



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Manufacturing and delivery



- Manufacturing includes the extraction of raw materials, extraction of energy carriers, generation of thermal and electrical energy, production of ancillary materials or pre-products, manufacturing processes of the products and all components.
- Delivery is described as a standard model, where the distance from plant to customer is assumed to be 1500 km. The mode of delivery is by truck.



Packaging	weight [kg]	weight [%]
PE	1,00E-03	0,27
Paper	3,68E-01	99,73
Not Considered	0,00E+00	0,00
Total Weight	3,69E-01	100,00





Use-stage

- During the use-stage, consumption of electricity and potential replacement of components is taken into account.

Use-stage model	
Scenario	Office
Reference Service Lifetime [years]	15
Total active time [hours]	37 500
Total passive time [hours]	93 900
Correction factors F _{CP} /F _D /F _O for dimming/presence detection	1/0,9/1
Energy Mix	EU

The Constant Illuminance Factor F_{CP} , the Daylight Dependency Factor F_D and the Occupancy Dependency Factor F_O are considered according to EN ISO 15193.

Energy consumption in the use-stage according to the use stage model
Nominal Power [W]





End of life

- The product is obliged to be professionally recycled in accordance with the EU Directive 2002/96/EC on waste of electric and electronic equipment (WEEE).
- The End of Life scenario is based on a material split and respective recycling rates. In the applied scenario, all metals are assumed to be recycled, plastics are incinerated. The remaining parts are land filled.



System boundaries

- For the life cycle assessment, the following stages have been considered:

Building assessment information (x = included in LCA)																
Building life cycle information																Supplementa ry information beyond the building life cycle
Product Stage			Construction Process Stage		Use-stage						End-of-Life Stage				Benefits and loads beyond the system boundary	
Raw material supply	Transport	Manufacturing	Transport	Construction installation process	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	Deconstruction / demolition	Transport	Waste processing	Disposal	Reuse, recovery or recycling potential
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
X			X	X				X								



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