PART 8 – Energy and Atmosphere (EA)



Introduction

Importance of the EA category and its effect green building design.

This credit category contains the <u>highest total points</u> because energy use and the burning fossil fuels are the biggest contributor to global warming. <u>The baseline energy usage</u> of the whole building will be calculated, allowing the discovery of innovative ways to reduce building energy usage.

Category	Points		
Location and Transportation	16		
Sustainable Sites	10		
Water Efficiency	11		
Energy and Atmosphere	33		
Materials and Resources	13		
Indoor Environmental Quality	16		
Total	100		
Bonus Points			
Innovation	6		
Regional Credit	lit 4		
Total	110		

LEED-certified projects use 24% less energy than regular buildings.

Five major sections:

- Energy demands
- Use of refrigerants
- Energy efficiency
- Renewable energy
- Ongoing performance



Energy demand

Green building projects need to set goals for <u>saving energy</u>. Projects will gain points according to their percentage energy reductions from their baseline energy usage by trying different design alternatives and products. This will take place under the "<u>Optimize Energy Performance</u>" credit. Some <u>strategies</u> to reduce energy demand of buildings.

Building orientation





Energy demand

Community planning



Adjacent buildings





Energy demand

Passive strategies



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Energy demand



Efficient building insulation







Energy demand

3D computer modelling



	Parete LETTO M (confi	ne: Esterno) 🗸 🗸		
	Parete LETTO M (confi	ne: Cucina) 🗸 🗸		
	Parete SCALE (confine: Esterno)			
	Progressivo	P151		
	Ambiente	Scale		
	Modello	MCV01-4 - Muratura		
	Trasmittanza [W/m²K]	0,800		
	Colore finitura	Medio		
	Confinante con	Esterno		
	Esposizione	OVEST		
	Superficie [m ²]	5,85		
	Inclinazione [°]	90,00		
	Ombreggiature	^		
	Angolo a,hor [°]	Angolo: 8,67°		
	Angolo a,fin [°]	Angolo: 86,97°		
	Angolo a,ov [°]	Assente		
	Parete SCALE (confine:	: Cucina) ^		
	Progressivo	P153		
	Ambiente	Scale		
	Modello	MCV01-4 - Muratura		
	Trasmittanza [W/m²K]	0,800		
	Confinante con	Cucina		
	Superficie [m ²]	0,36		
	Inclinazione [°]	90,00		



Energy demand

Energy audit



Rightsizing



Use of refrigerants

Green buildings need to address the types of refrigerants used in the project.

Refrigerants are the substances mostly used in air conditioning and refrigeration systems. Refrigerants in building systems deplete stratospheric <u>ozone</u>, contributing to climate change.

The 1987 Montreal Protocol banned the CFC refrigerants, and it is also phasing out HCFC refrigerants.

The destructive potential of these chemicals is measured by both their **ozone depletion potential** (ODP) and **global warming potential** (GWP).

LEED BD+C projects aiming for a LEED certification <u>cannot use any CFC refrigerants</u>, and existing buildings should complete a total CFC phase-out prior to project completion.



Use of refrigerants

The **natural refrigerants** are much more environmentally friendly than the others, which are CO2, H2O, NH3, and hydrocarbons. A natural refrigerant's ODP and GWP values are zero or very close to zero. However, they are <u>less effective</u> than the HCFC.



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Property	ODP	GWP	Toxicity	Flammability
Refrigerant				
CFC-11	1	4500	no	no
CFC-12	1	8500	no	no
HCFC-22	0.055	1700	no	no
HCFC-142b	0.0065	2000	no	no
HFC-32	0	580	no	yes
HFC-125	0	3200	no	no
HFC-134a	0	1300	no	no
HFC-152a	0	140	no	yes
Ammonia	0	0	yes	no
Carbon di-oxide	0	1	no	no
Propane	0	3	no	yes
Butane	0	3	no	yes
Water	0	0	no	no

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Energy efficiency for HVAC systems

In the United State, HVAC systems account for 30% of the energy used in commercial buildings and nearly 50% of the energy used in residential buildings.

<u>Synergic strategies</u>: install a building envelope that can result in installing a smaller HVAC system because of the high <u>level of insulation</u> provided by the envelope.

40% of the energy used to heat and cool the average building was lost to <u>air leaks</u> in the building envelope.





Energy efficiency for HVAC systems

When choosing HVAC equipment, a project team needs to pay special attention to its <u>operating</u> <u>efficiencies</u>.

Increasing the <u>thermal mass</u> of a building is another strategy for downsizing the HVAC equipment.

In appropriate buildings, using <u>natural ventilation</u> can be another great strategy to reduce energy usage and provide fresh air to the building occupants.



Projects can capture <u>efficiencies of scale</u>, and multiple buildings can share the HVAC system.



Energy efficiency for lighting

<u>Daylighting</u> is surely the best strategy, as it saves energy and increases the well-being of building occupants.

For artificial lighting, selecting appropriate <u>light bulbs</u> is one of the factors that will affect energy efficiency. Incandescent lights vs fluorescent lights or LEDs.

By installing an adequate number of <u>lighting controls</u> for individual users, projects can cut down their lighting costs since these devices will shut off lights when lighting is not needed.







Energy efficiency for appliances

When choosing appliances for building use, project teams need to consider the energy efficiencies of different alternatives. Appliances with ENERGY STAR labels can be a smart choice.





Monitor and verify performance

Monitoring and verifying building efficiency performance is essential to ensure that the building systems are functioning as designed. A <u>building automation system</u> (BAS) is a computer-based monitoring system that can monitor, coordinate, and control every individual building system.



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Renewable energy

Renewable energy includes <u>solar</u>, <u>wind</u>, <u>wave</u>, <u>biomass</u>, and <u>geothermal</u> power, plus certain forms of <u>hydropower</u>. The use of renewable energy sources avoids the <u>environmental impacts</u> associated with the production and consumption of nonrenewable fuels.

Renewable energy sources can be either **on-site** (such as solar photovoltaic) or **off-site** (purchase of <u>green power</u> from a utility or a provider of <u>renewable energy certificates</u>, REC). A REC is the proof that when purchased, an amount of energy was created using renewable-energy sources.

Green-e is the leading certification program for green power generation in the United States. LEED requires project to use **Green-e Energy certified** green power.

Carbon offsets allow projects to fund companies that reduce or remove carbon emission. A carbon offset is a reduction of carbon dioxide made in order to compensate for an <u>equivalent</u> <u>carbon dioxide emission</u> made elsewhere.

The main goal is to establish **carbon neutrality**, which is to emit no more carbon emissions than can realistically be offset. A carbon offset needs to be **Green-e Climate certified**.

Carbon footprint refers to the measure of greenhouse gas emission associated with an activity.



Renewable energy

Solar power <u>Active solar power</u> converts sunlight into light, heat or electricity.



PV panels

Solar thermal collectors



Renewable energy

On site – Solar power

<u>Passive solar</u> power optimizes the project design to use sunlight more effectively. As it is a passive strategy, its function is not about generating energy from solar energy via equipment.

PASSIVE DESIGN STRATEGIES





Renewable energy

On site – Geothermal heat pumps

<u>Geothermal heat pumps</u> are central heating and/or cooling systems that transfer heat to or from the ground.



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Renewable energy

Off-site – *Wind energy* Wind turbines directly convert the energy of the wind to electricity.





Renewable energy

Off-site – *Hydro energy*

Hydro energy converts water-flow energy into electricity.





Renewable energy

Off-site – Biofuel

Biofuel-based electrical systems can create electricity from biofuels.







Renewable energy

Off-site – Wave power Wave energy converters can convert the energy of waves into electricity.



Renewable energy

Off-site – *Tidal power*

Tidal power converts the energy of tides into electricity.

Ongoing performance

During the <u>building operation phase</u>, it is crucial to ensure that a project functions as designed, and it should additionally sustain this performance over time.

The <u>actual performance</u> of the building should be compared with building performance measurements from an energy simulation tool (EPA's ENERGY STAR Portfolio Manager).

<u>Commissioning</u> is a systematic investigation by skilled personnel that compares building performance with the project goals, design specification and owner's project requirements (OPR) set during the early design. <u>Ongoing commissioning</u> for building operations ensures that the building continues to operate according to its fundamental operational requirements.

<u>Retro-commissioning</u> is basically the same process of commissioning applied to <u>existing</u> <u>buildings.</u>

Ongoing performance

During the ongoing performance implementation, projects need to do the following:

- Adhere to the owner's project requirements (OPR)
- Provide staff training
- Develop a preventive maintenance program
- Create incentives for occupants and tenants

Strategies to address Energy and Atmosphere

- Establish energy design goals
- Size the building appropriately
- Use free energy as much as possible
- Orient the building in order to minimize energy use
- Insulate the building
- Address the building envelope
- Implement passive strategies to lower energy use
- Use natural ventilation where appropriate
- Use high-performance mechanical systems and appliances
- Use high-performance lighting
- Install lighting controls
- Conduct energy audits
- Use refrigerants with low ODP and GWP values
- Capture efficiencies of scale
- Develop an energy simulation and compare building performance
- Generate on-site renewable energy
- Purchase off-site renewable energy
- Purchase carbon offsets

Strategies to address Energy and Atmosphere

- Implement commissioning and retro-commissioning
- Monitor and verify building performance
- Adhere to the owner's project requirements
- Provide staff training
- Develop a preventive maintenance program
- Create incentives for occupants and tenants

