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Mitigation Enabling Energy Transition in the MEDiterranean region

ENERGY DESIGN AND EQUIPMENT (EDE)- INTRODUCTION

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Training on GRASSMED – meetMED II

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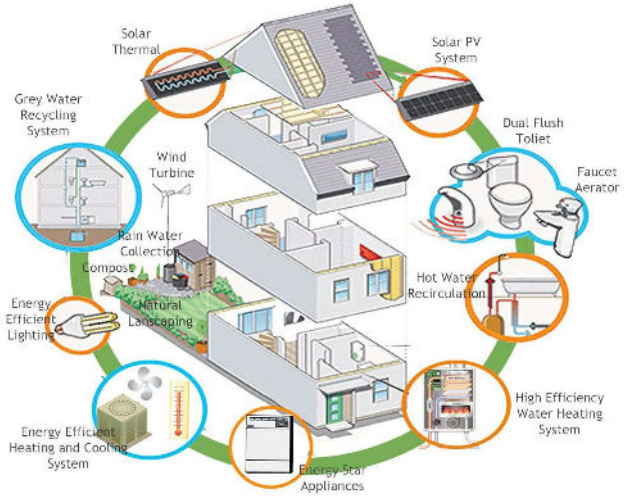
OUTLINE

- ✓ What are Energy systems Design and Equipment in regards to Green Buildings?
- ✓ What are the Major Goals of Proper "Energy systems Design and Equipment"?
- ✓ What are the Factors in Play?
- ✓ Guiding Principles for Energy systems Design and Equipment
  - Choosing Solar Water Heating
  - Using Renewable Energy Technologies
  - Implementing Daylight Design
  - Utilizing Natural & Mechanical Ventilation
  - Considering Building & Parking Lighting Efficiency
  - Designing and Selecting Systems (HVAC, Boilers…) and Air Curtains
  - Having Back Up Electricity
  - Promoting Building Management Systems.
- ✓ Grass Tool

What are Energy systems Design and Equipment in regards to Green Buildings?

- **Energy-efficient buildings are designed and built to use less energy** than a conventional building of the same size.

- "**Energy System Design and Equipment**" in green building refers to the design and selection of **energy-efficient systems** and equipment that **minimize energy consumption and reduce greenhouse gas emissions** in buildings



- These systems and equipment can include **heating**, **ventilation**, and **air conditioning (HVAC)** systems, **lighting** systems, **renewable energy systems** (such as solar water heating systems, solar panels or wind turbines), and **Building Management System**

What are the Major Goals of Proper "Energy Design and Equipment"?

- Energy Efficiency: Energy-efficient systems and equipment **can significantly reduce energy consumption, CO2 and other pollutant gases emission**
- Cost Savings: Energy-efficient systems and equipment **can save building owners and occupants money on Energy bills over time.**
- Comfort: Energy-efficient HVAC systems **can improve indoor air quality** providing adequate ventilation, humidity and temperature.

Energy-efficient systems and equipment can reduce building environmental impacts and than help to create more eco-friendly and sustainable buildings.

What are the Factors in Play?

- **Renewable Energy Systems:** Renewable energy systems such as **Solar Water Heater, Photovoltaic system, wind turbines..**
- **Daylight and Natural ventilation Design: toward a bioclimatic building concept**
- **Lighting Systems**: Lighting is a **significant contributor to energy consumption** in buildings and Parking spaces.
- **Heating, Ventilation, and Air Conditioning (HVAC) Systems:** HVAC systems are one of the **largest consumers** of energy in buildings
- **Building Management Systems:** BMS can be used **to control and optimize the energy consumption of systems**, including HVAC and lighting.
- **Efficient Back-Up power systems:** Reduce Environmental Impacts of Diesel Generators **by selecting proper exhausts with gas filtration and heat recovery systems**

What are the Different Outlines to Evaluate?

There are 8 important outlines to evaluate a building's Energy systems design and selection of Equipment, in GRASSMED.

Choosing Solar Water Heating

- Hot water demand and the appropriate sizing
- High-efficiency products
- Proper orientation
- Appropriate controls and sensors

Using Renewable Energy Technologies

- Identify and size
- High-quality products
- System monitoring and maintenance

Daylighting Design

- Orientation for better natural lighting
- Energy efficient glazing and shading
- Appropriate controls and sensors
- Using interior design strategies

Considering Building & Parking Lighting Efficiency

- Efficient lighting fixtures
- Lighting controls and proper design
- Daylighting strategies

Utilizing Natural & Mechanical Ventilation

- Determine occupancy
- Use natural ventilation where possible
- Use efficient Mechanical ventilation

Designing and Selecting Systems (HVAC, Boilers…) and Air Curtains

- High-efficiency products
- Proper sizing
- air curtains to separate indoor and outdoor environments

Having Back Up Electricity

- Reliable back-up system
- Proper sizing
- High-efficiency products

Promoting Building Management Systems

- Implement BMS to monitor and control
- Use data analytics and AI to optimize consumption
- Regular maintenance

TOOLS

GRASS Tool

Energy System Design and Equipment

- EDE1 - Solar Water Heating
- EDE2 - Renewable Energy
- EDE3 - Daylight Factors
- EDE4A - Natural Ventilation
- EDE4B - Mechanically Controlled Ventilation
- EDE5A - Efficient Lighting
- EDE5B - High Efficiency Parking Structure Lighting
- EDE6A - Efficient Boiler /HVAC
- EDE6B - Air Curtains
- EDE7 - Back Up Electricity
- EDE8 - Building Management System

- % of Hot Water Demand Covered
- % of Renewable Energy
- Average Daylight & Compliance Factor
- Good Practices and Design Recommendation
- Mechanical Ventilation Requirement (Flow rate in cfm)
- Power density ≤ 2.5 W/m2/100lux
- Covered LE>50lm/W
  Uncovered LE>60 lm/W
- AFUE / IEF% calculation
- Design Requirement
- Exhaust Stack/ Innovation
- BMS components

		Commercial	Residential	Total Com	Total Res
Envelope	E1	150	150		
	E2	26	26		
	E3	15	15	191	191
Green Sites	GS1	7	10		
	GS2	4	10		
	GS3	4	10		
	GS4	15	10		
	GS5	24	23		
	GS6	24	4	78	67
Energy Design and Equipment	EDE1	8	30		
	EDE2	15	15		
	EDE3	20	20		
	EDE4A	20	20		
	EDE4B	10	10		
	EDE5A	25	15		
	EDE5B	8	8		
	EDE6A	35	35		
	EDE6B	6	0		
	EDE7	15	15		
	EDE8	15	15	177	183
WMHB	WMHB1	29	29		
	WMHB2A	21	26		
	WMHB2B	29	29	79	84
				525	525

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% of Hot Water Demand Covered

$$\%\ \text{HWD covered} = \frac{\text{Actual Area of Collector}}{\text{Approximated Area for 100\% coverage}} \times 100$$

Percentage of Hot Water Demand Covered (%HWD)	Scoring Points
≤50%	12
50.1% - 60%	16
60.1% - 70%	20
70.1% - 80%	24
≥ 80.1%	28

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% of Electrical Renewable Energy

$$\%\ \text{Electrical Energy RE} = \frac{\text{Annual Electrical Energy from RE}}{\text{Annual Electrical Demand}} \times 100$$

% Renewable energy	Score
4%-10 %	6
11%-20 %	9
21%-30%	12
> 30 %	15

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Average Daylight & Compliance Factor

$$\mathbf{ADF}(\%) = \frac{\mathbf{V_t} \times \mathbf{A_{Glazing}} \times \boldsymbol{\theta}}{\mathbf{A_S} \times (1 - \mathbf{R}^2)}$$

- **Vt**: transmittance of glass including dirt effect.
- **AGlazing:** net glazing area.
- **Θ:** the sky exposure angle, in degrees, the portion of the sky visible from the center of the window.
- **As**: total area of internal surfaces (i.e. the sum of the total surface area of walls including windows, ceiling, and floor).
- **R:** equivalent reflectance of surfaces of walls, ceiling, floors.

$$\mathbf{CF} = \frac{\mathbf{Total\ Floor\ Area\ of\ spaces\ having\ ADF} \geq 2\%}{\mathbf{Total\ Floor\ Area\ of\ occupied\ spaces}} \times 100$$

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Average Daylight & Compliance Factor

Compliance Factor CF	Scoring Points
70% ≤ CF ≤ 80%	6
80.1% ≤ CF ≤ 90%	8
CF ≥ 90.1%	10
Requirements	**Scoring Points**
Install Manual Internal Shading	1
Install Automatic Internal Shading	2
Distribute Lighting Fixtures properly	3
Install Lighting Control Strategy	4

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Natural Ventilation Requirements

Design recommendation	Scoring Points
Maximize wind-induced ventilation by siting the ridge of a building perpendicular to the summer winds	5
Each room should have two separated supply and exhaust openings: 1.Locate exhaust high above inlet to maximize stack effect 2.Locate openings away from outdoor sources of pollutants and noise	3 3
Provide ridge vents	1
Allow for adequate internal airflow	1
Consider the use of clerestories or vented skylights	1
Apply Ventilation Configuration properly	6

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Mechanical Ventilation Requirement

Meet the minimum requirements of ventilation rate in ASHRAE 62.2

$$\mathbf{CFM = 0.01(ASF) + 7.5(NBR + 1)}$$

- **Asf:** area of the bedroom
- **Nbr:** number of bedrooms

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Mechanical Ventilation Requirement

Mechanical Ventilation requirement	Scoring Points
Conformity of Ventilation Rate in CFM	Prerequisite + 4
Install Ventilation Control (CO_2 sensors)	2
Install Energy Recovery unit (ERV), or Heat Recovery unit (HRV)	4

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Luminaire Efficacy

Requirements	Scoring points
Total Power installed ≤ 2.5 W/m²/100 lux	15- residential 25- commercial
No Incandescent lamps are installed	
Install lamps to be efficient within their typical applications	
Proposed equipment must be UL, ETL or equivalent	
Replace electromagnetic ballast by electronic ballast	

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Parking Luminaire Efficacy

Case 1: all the parking lots are underground or covered.	**Scoring Points**
LE > 60 lm/W	2
Case 2: all the parking lots are uncovered.	**Scoring Points**
LE > 50 lm/W	2
Case 3: parking area is divided into covered and uncovered lots.	**Scoring Points**
Covered: LE > 60 lm/W	1
Uncovered: LE > 50 lm/W	1
Parking Structure Luminaire General Secondary Requirements for both covered and uncovered	**Scoring Points**
Replace traditional high-intensity discharge (HID) lighting sources with highly efficient lighting, preferably light-emitting diode (LED).	2
Achieve Minimum Horizontal lux value with respect to type of parking area	1
Achieve Minimum Vertical lux value with respect to type of parking area	1
Stain the ceilings white	1
80% of the luminaire material by weight should be recyclable at end of life.	1

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Boiler/Furnace Requirements

Design Requirements	Scoring Points
Boiler/Furnace AFUE	**Scoring Points**
Mid-efficiency: 80%–85%	3
Intermediate-efficiency: 85.1%–89.9%	5
High-efficiency: ≥ 90%	7
Boiler/Furnace Exhaust Stack criteria	**Scoring Points**
Far from air intakes of other buildings	1
Mid-efficient Air Filters	1
High-efficient Air Filters	2
Boiler/Furnace Innovation	**Scoring Points**
Condensing unit	1
Heat Recovery Application	2
Energy Star label or equivalent label	1
Install CO detector	1

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Increase in Efficiency Factor IEF

$$\text{IEF} = \frac{\text{Installed Efficiency} - \text{Minimum Requirement}}{\text{Minimum Requirement}} \times 100$$

IEF	Scoring Points
0% ≤ IEF ≤ 5%	4
5.1% ≤ IEF ≤10%	6
10.1% ≤ IEF ≤20%	8
IEF ≥ 20.1 %	12

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Back-up Energy Requirements

Requirement Applied	Scoring points
Install Sound Attenuators and Vibration Dampers	Prerequisite 1
Install catalyzers for air filtration	2
Exhaust Stack's Specifications	**Scoring points**
Install Effective optimal exhaust stacks	Prerequisite 2
Install away from air intakes of other building	1
Innovation	**Scoring points**
Install Heat Recovery unit	7
Use 2% - 5% Biodiesel fuel	1
Use 5.1% - 10% Biodiesel fuel	2
Use 10.1% - 15% Biodiesel fuel	3
Use 15.1% - 20% Biodiesel fuel	4
Use ≥ 20.1% Biodiesel fuel	5

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BMS Requirements

BMS comprises	Scoring Points
Power Systems control (PV, Generator,…)	2
Electric Appliance control	3
Heating, Ventilation and Air-conditioning HVAC System / CO_2 sensors for Mechanical Ventilation control	10
Illumination system control	Refer to credit EDE-5A - lighting

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