ENERGY EFFICIENCY IN BUILDINGS

Nguyen Thuy Trang
Associate Programme Officer
Capacity Development Unit
UN-Habitat
WHY ENERGY EFFICIENCY IN BUILDING?

• A large proportion of energy being consumed:
  • European Union countries: > 40%
  • Philippines 15-20%
  • Brazil 42%
  • Florida/USA 47%
  • California 66%

• Globally the building sector consumes: 42% electricity consumption (IEA)
WHY ENERGY EFFICIENCY IN BUILDING?

• Energy security
• Carbon-footprint / GHG emissions
• Investment in EE is often cheaper than investment in new energy supply
• Multiple benefits: better comfort, higher property values etc.
WHAT IS ENERGY EFFICIENCY IN BUILDING?

- The extent to which the energy consumption per square-metre of floor area of the building measures up to established energy consumption benchmarks for that particular type of building under defined climatic conditions.

- kWh/m²/annum

- \( E = \frac{T(\text{kWh/annum})}{(S_1 + S_2 + S_3 + \ldots + S_n)(m^2)} \)

- heating,
- cooling, air-conditioning, ventilation,
- lighting,
- fans,
- pumps and controls,
- office or other electrical equipment, and
- external lighting
WHAT IS ENERGY EFFICIENCY IN BUILDING?

- \( T = \text{Usage} + \text{Loss} \)
- \( \text{Loss} = \text{System operation heat waste} + \text{Leaking} + \text{Through material} \)
- \( \text{Heat loss through material (U-Value)} \)

BUILDING CODE

- Windows
- Doors
- Walls
- Skylights
CALIFORNIA’S ENERGY EFFICIENCY IN BUILDING – A CASE OF SUCCESS

• Building and Appliance Standards since 1975
• $US 5 billion were committed by industry for energy efficiency information, technical assistance and incentive programmes
• 85% of this fund was used for retrofitting EE investment in existing building

- 13 million existing buildings
- 200,000 new building each year
CALIFORNIA’S ENERGY EFFICIENCY IN BUILDING – A CASE OF SUCCESS

Energy savings gained within existing buildings

Total electricity sales, per capita, in US and in California, 1960 - 2004
METHODOLOGY

A typical energy flow in buildings

Source: EU
METHODOLOGY

- Natural energy gain:
  - Passive solar heating,
  - passive cooling,
  - natural ventilation flow,
  - daylight

Maximize

- Building site
- Shape of building
- Orientation of building
- Thermal insulation
METHODOLOGY

• Internal heat gain:
  • People
  • Lighting
  • Appliances
  • Equipment

In cold climate
  Reduced or increased energy consumption

In hot climate
BUILDING’S ENERGY PERFORMANCE

Energy use indicators for buildings

Source: EU
BENCHMARKS

- **Modeled benchmarks** obtained by using a simulation model to determine the performance of a building, usually at the design or refurbishment stage.

- **Imperial benchmarks** obtained from statistical data from detailed studies of 20-100 buildings per sector.
BUILDING ENERGY AUDIT

- Term of Reference
- Building energy performance: indicators and benchmarks
- Proposing measures
- Cost-benefit analysis
- Investment plan
CERTIFYING ENERGY EFFICIENCY FOR BUILDINGS

- Inform tenants and prospective buyers of the expected running costs;
- Create public awareness;
- Act as a prerequisite of measures to improve its energy efficiency;
- To effect incentives, penalties or legal proceedings.
- Modeled benchmarks $\rightarrow$ Asset rating
- Imperial benchmarks $\rightarrow$ Operational rating
Energy Certificate

Building Energy Performance

Certificate type: FULL Office
Whole or part of building: Whole building

Very Energy Efficient

A
B
C
D
E
F
G

Not Energy Efficient

Asset rating: A
Operational rating: B

Further information can be found in the Energy Log Book

GB 2004

Certifying organization
Street
PO Box
City
Contact
Email

Building name
Street
City
Contact
Email
ENERGY EFFICIENCY MEASURES FOR BUILDINGS

• Reducing heating demand
  • Limiting the exposed surface area
  • Improving the insulation of the building’s fabric
  • Reducing ventilation losses;
  • Using efficient heating systems with effective controls
ENERGY EFFICIENCY MEASURES FOR BUILDINGS

• Reducing cooling demand
  • Solar control glass;
  • Use of shading
  • Reducing internal heat gains;
  • Separate high heat load process from general house
  • Making use of thermal mass and night ventilation to reduce peak temperatures;
  • Providing effective natural ventilation;
  • Green roof/green facade
  • Reducing lighting loads and installing effective lighting controls.
ENERGY EFFICIENCY MEASURES FOR BUILDINGS

- **Reducing the energy requirements for ventilation**
  - Building design
  - Effective window design
  - Mix mode ventilation;
  - Reducing energy use for mechanical ventilation
ENERGY EFFICIENCY MEASURES
FOR BUILDINGS

Source: EU

Control of complete air flow pattern

W_{max} \leq 5H
12 m depth is the practical maximum

Source: EU
ENERGY EFFICIENCY MEASURES FOR BUILDINGS

Source: EU
ENERGY EFFICIENCY MEASURES FOR BUILDINGS

• Reducing energy use for lighting
  • Maximizing the use of daylight
  • Energy-efficient lighting system
  • Lighting controls

• Reducing energy used for heating water
  • Time controls
  • Thermostat control to set temperature of water used for washing (56-60°C)
  • Suitable warm water design
ENERGY EFFICIENCY MEASURES
FOR BUILDINGS

• Reducing energy use for lighting
  • Maximizing the use of daylight
  • Energy-efficient lighting system
  • Lighting controls

• Reducing energy used for heating water
  • Time controls
  • Thermostat control to set temperature of water used for washing (56-60°C)
  • Suitable warm water design
EXERCISE

• From the presented measures:
  • List those that are at the lowest costs
  • List those that are more easy to implement