MEBS6016 Energy Performance of Buildings

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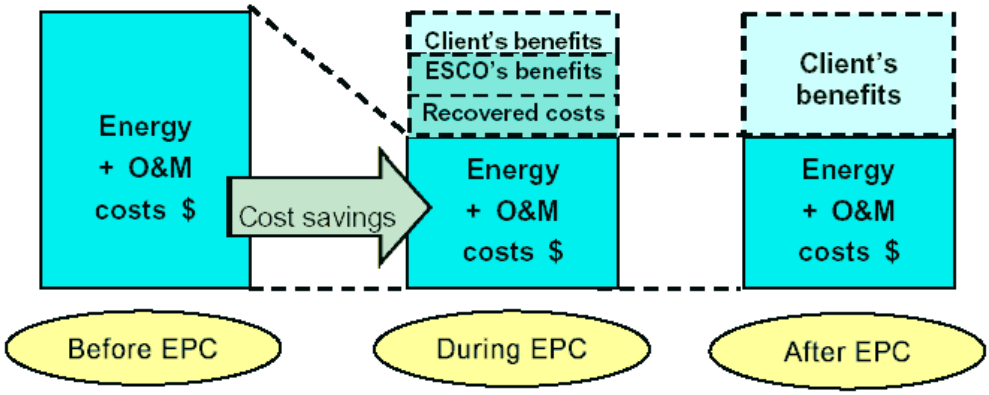
Self-evaluation Exercise (Suggested Solutions)

1. What is energy performance contracting (EPC)? What are the possible benefits of EPC to a building owner when he considers it for a building retrofit. Briefly discuss the potential and barriers of EPC development in Hong Kong.

Answer: (* Outline of the solution only)

Energy performance contracting (EPC), also known as energy savings performance contracting, is a financing technique to raise money for energy efficiency investments based on future savings. Usually, the energy services companies (ESCO) offer the EPC services, without upfront capital on building owners. The basic concept of EPC is shown in the following diagram:



Possible benefits of EPC to a building owner when he considers it for a building retrofit:

- Reduced risk (contractor guarantees)
- Turnkey services (contractor provides all services)
- The business needs less internal expertise
- Project financing can be 'off balance sheet'
- Advanced products & services can be used
- Savings can be much higher than done by itself
- Additional improvements to built environment

The potential and barriers of EPC development in Hong Kong:
Potential ESCO market in HK:

- Energy cost is a concern for developers/owners
- Vast stock of existing buildings (esp. commercial)
- Potential market around US$100 million
- ESCO prefer owner-occupied or single-tenant
- Air-conditioning & lighting are major areas
- Savings not difficult to obtain from equipment optimisation, retrofitting or retrocommissioning

Major barriers at present:

- Weak awareness & experience
- Complex legal & contractual issues
- Problems with conventional procurement process
- Problems with measurement & verification

2. An office building with a total gross floor area of 12,000 m^2 has used 1.8 x 10^6 kWh of electricity in one year. The annual cost of electricity is $2 millions and this includes both energy charge and demand charge. If the demand charge constitutes 20% of the annual electricity cost, determine the following indicators for energy performance. Assume the ratio of net floor area to gross floor area is 0.8.

   i) Energy utilization index (kWh/m^2/year), based on net floor area.

   ii) Energy cost index ($/$m^2$/year), based on net floor area.

   If this building is compared with a group of office buildings with an energy benchmark shown on the following graph, determine the percentile of this building and comment on the performance level.

Answer: (* Outline of the solution only)

Net floor area = 0.8 x Gross floor area = 0.8 x 12,000 = 9,600 m^2

Energy charge = annual electricity cost x (1 – 20%)

i) Energy utilization index, based on net floor area is:

1.8 x 10^6 / 9,600 = 187.5 kWh/m^2/year (or 675 MJ/m^2/year)

ii) Energy cost index, based on net floor area is:

$2 x 10^6 x (1 – 20%) / 9,600 = $166 /$m^2$/year

From the given energy benchmark graph, at 675 MJ/m^2/year the percentile is about 44%. That means, 56% of the building population in this group is having energy consumption level higher than this building while 44% of the building population is having energy consumption level lower than it. This building is close to the median or average in the group.

3. For an energy efficiency project, the system will cost $50,000 installed and has a life time of 10 years. It will require $10,000 worth of maintenance each year and the energy costs will be $60,000 per year. If this system is not installed, the building will still require $5,000 worth of maintenance each year and the energy costs will be $100,000 per year.

   If the discount rate is assumed 10%, calculate the LCC and determine if the investment on this system is effective.

Answer: (* Outline of the solution only)

Option 1: the energy efficient system is installed

- Initial cost = $50,000

- Maintenance cost = $10,000 per year
- Energy cost = $60,000 per year
- Total annual costs = $10,000 + $60,000 = $70,000 per year

Option 2: the energy efficient system is NOT installed

- Initial cost = $0
- Maintenance cost = $5,000 per year
- Energy cost = $100,000 per year
- Total annual costs = $5,000 + $100,000 = $105,000 per year

Assume discount rate 10% and the study period is 10 years, present worth factor is:

$PWF = [1 - 1/(1 + 0.1)^{10}]/0.1 = 6.145$

Therefore the LCC results are:

LCC (Option 1) = $50,000 + $70,000 x 6.145 = $480,150

LCC (Option 2) = $0 + $105,000 x 6.145 = $645,225

Since Option 1 has a lower LCC, the energy efficiency system is effective & shall be installed.