MINNESOTA
WASTE WISE
FOUNDATION

Lighting – Upgrade Investment Analysis

The following example illustrates a complete investment analysis for a lighting upgrade. Included are several steps needed to determine if the lighting upgrade is a cost-effective. Investment calculations include simple payback, internal rate of return, savings to investment ratio, and life cycle cost analysis.

Lighting — Background
Our staff identified a lighting upgrade opportunity during an on-site energy consultation. The building had a combination of:

- T12 fluorescent fixtures with magnetic ballasts
- Incandescent lamps

These types of systems are commonly replaced with new T8 fluorescent fixtures with electronic ballasts and compact fluorescent lamps (CFLs). During the on-site consultation, an inventory of the existing lighting system was recorded on a spreadsheet and included the following for existing and proposed lighting:

- fixture type
- number of fixtures
- input wattage per fixture
- hours of use per year

Now we'll determine whether this is a good investment.

Investment Analysis
We know that this buildings existing lighting system is using approximately 39,000 kilowatt-hours (kWh) of energy and costs $4,369 per year. Based on the existing light output of the existing lighting system, the proposed fixtures were chosen to produce the same light outputs and greatly reduce the energy use.

The T12 fixtures will be replaced with higher efficiency T8 lamps and electronic ballasts, the incandescent exit signs will be replaced with LED exit signs, and all the incandescent flood lamps will be replaced with compact fluorescent lamps (CFLs).

The proposed system would use approximately 15,000 kilowatt-hours of energy cost about $1,684 per year. That is an estimated 38% reduction in energy use for this lighting system upgrade.

With this information in hand, the next step is to evaluate whether the lighting upgrade project is an attractive investment. We'll start with the most basic investment analysis and work our way toward determining if the project is acceptable base on your minimum attractive rate of return (sometimes known as your company's minimum internal rate of return).

Simple Payback Period (SPP)

Simple Payback Period is generally the number of years required to recover the initial investment through project savings. This is a good first cut investment analysis tool, but it doesn't take into account the time value of money. In this case we've taken the total project cost minus the rebates and divided that amount by the annual savings.

Using the example above, the total estimated project cost is $9,298, the rebate amount is $1,779, and the annual savings amount is $2,685.

SPP = (Project Cost – Rebate)/Annual Savings
SPP = ($9,298-$1,779)/$2,685
SPP = 2.80 years

Internal Rate of Return (IRR)

Internal Rate of Return is designed to calculate the rate of return that is "internal" to the project. If you know what your company's minimum attractive rate of return (MARR) is, an IRR that is higher than your MARR is an attractive project.

Again, using the example above, we know the total project cost after rebate is $7,519 and the annual saving is $2,685. This company's MARR is 15% and the new lighting system is expected to last 10 years. In order to determine the IRR the following equation should equal zero by using a trial and error approach.

The expression '(P/A,IRR,n)' comes from Time Value of Money tables commonly used in economic analysis interest tables. In this case, P stands the present value (to be determined), A stands for the annualized savings, IRR stands for the Internal Rate of Return for this project, and n stands for the number of years the project will last or the life span of the project.

Present Worth = -(Project Cost – Rebate) + Annual Savings * (P/A,IRR,n) = 0

PW = -$7,519 + $2,685*(P/A,IRR,10) = 0
Starting with an IRR of 15% …
PW = -$7,519 + $2,685*(P/A,15%,10)
PW = -$7,519 +$2,685*(5.0188)
PW = -$7,519 + $13,475
PW = $5,956 > 0

Let's try an IRR of 25% …
PW = -$7,519 + $2,685*(P/A,25%,10)
PW = -$7,519 +$2,685*(3.5705)
PW = $2,068 > 0

We know this project is well above the MARR making this a very attractive project.

Savings to Investment Ratio (SIR)
Savings to Investment Ratio is designed to determine how many times the project would pay for itself throughout its lifetime.

SIR = Total Savings/Investment
SIR = $2,685(P/A,15%,10)/$7,519
SIR = $2,685(5.0188)/$7,519
SIR = $13,475/$7,519

SIR = 1.79 which is greater than 1.00 so this would be an attractive project.

Life Cycle Cost Analysis (LCC)
Life Cycle Cost Analysis is used to calculate the cost of a system over its entire life span. LCC takes into account all cost, savings, maintenance, and salvage values in order to compare multiple project options to determine which project has the lowest overall cost throughout its life.

We'll once again use the example above and compare it to a system that uses less energy but has a higher initial investment. For simplicity, we've assume that both projects have the same life span and neither system has a salvage value at the end of life.

Option 1 (LCC1)
Total Project Cost: $9,298
Rebate Amount: $1,779
Project Life (years): 10 years
Annual Savings: $2,685
Yearly Maintenance Costs: $345
Salvage Value: $0
LCC1 = $9,298 – $1,779 + $1,684(P/A,15%,10) + $345(P/A,15%,10) + $0
LCC1 = $9,298 – $1,779 + $1,684(5.0188) + $345(5.0188) + $0
LCC1 = $17,702.20

Option 2 (LCC2)
Total Project Cost: $12,454
Rebate Amount: $1,875
Project Life (years): 10 years
Annual Savings: $2,965
Yearly Maintenance Costs: $450
Salvage Value: $0
LCC2 = $12,454 – $1,875 + $1,774(P/A,15%,10) + $450(P/A,15%,10) + $0
LCC2 = $12,454 – $1,875 + $1,774(5.0188) + $450(5.0188) + $0
LCC2 = $21,740.80

Looking at the results above you can see that Option1 (LCC1) has the lower life cycle cost and would be the more attractive option.