De Anza ES 70 Energy Economics

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What are Economic Analyses?

- Decision making tools for energy projects
- Techniques to choose the best among several options
- Does not include non-economic benefits
  - Environment
  - Society
  - "Good Neighbor"

Objectives

- Understand that economic analyses can range from simple to complex
- Be able to review and understand assumptions
- Become familiar with the limits of Economic Analysis
- Become familiar with example calculations

Types of Economic Analyses

- Rough order of magnitude estimates (ROM) for budget purposes
- Simple Payback
- Internal Rate of Return (IRR)
- Used on both new building projects and retrofits
  - Glazing, HVAC, chiller & boiler selection, alternative energy projects

Investment Decision Types

- Accept or reject a single project or system option
- Select an optimal efficiency level for a building system
- Select an optimal system type from competing alternatives
- Select an optimal combination of interdependent systems
- Rank competing projects to allocate a limited budget

Assumptions are Key!

- **Define the project and state the objectives!!!**
- First cost
- Cost of energy (Tariff rate)
- Cost of labor & Materials
- Cost of maintenance
- Cost of money, tax credits
- Inflation

Simple Payback

- Simple payback = Cost / Savings
- Measures how long it will take to recover a cost-saving investment
- Does not account for cost of money or length of project

Simple Payback cont.

Simple Payback(in years)=
Cost / Savings
Where:
Cost = Cost of project (in dollars)
Savings = Annual energy savings (in dollars)

Cost

- List assumptions and sources
- Use the cost difference between options

Savings

- List assumptions and sources
- Use the savings difference between options
- Convert all units to dollars per year

Refrigerator Example

- Assumptions:
  - Extra first cost
    - Energy Star = $890
    - Brand "X" non energy star = $860
  - Energy = 0.177 $/kWh A-1 PG&E Rate
    - Energy Star = 556 kWh/yr or $98.41/yr
    - Brand "X" = 695 kWh/yr or $123.02/yr
  - www.epa.gov/nrgystar/purchasing
    - see "Savings Calculator"

Refrigerator Example cont.

- Simple Payback = Cost/savings
- Cost = $890-$860 = $30
- Savings = $123.02 – $98.41 = $24.61
- Simple Payback = $30/$24.61 = 1.21 years

Water Heater Example

- Natural Gas v Electric
- Energy Costs (www.pge.com)
  - Gas @ $0.70 therm = $195 year
  - Electric @ $0.177 kWh = $952 year
- First Cost (www.grainger.com)
  - Gas = $405
  - Electric =$168

Water Heater cont.

- Simple Payback = Cost/Savings
- Cost = $405-$168 = $237
- Savings = $952/yr - $195/yr = $757/yr
- Simple Payback = $237/$757 = .31 years! (4 mos)
- But Wait!
  - Installation cost
  - Permits

More Assumptions for Water Heater…

- Energy cost
- First cost materials
- First cost Labor
- Delivery
- Installation cost
- Venting cost
- Gas line cost
- Wall repair/Painting
- "Downtime" cost
- Disposal Cost
- Permit cost
- Alternatives?

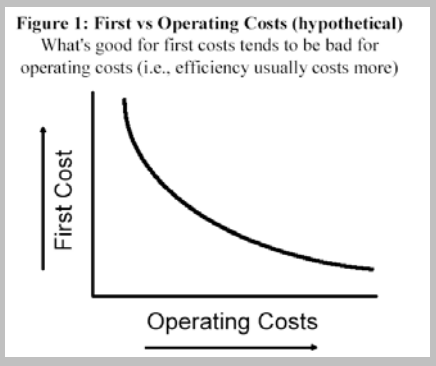
Compact Fluorescent Example

- Compare Incandescent to Compact Fluorescent Lighting
- First Cost (www.bulbs.com)
  - Incandescent $0.58 75 w 1150 lumens
  - Compact Fl. $15.62 20 w 1200 lumens
- Energy cost A1 Rate(www.pge.com)
  - $0.177 /kWh

Compact Fluorescent cont.

- Assume 100 lamps
- Annual hours of operation
  - Case 1. Assume 9 hrs per day, 5 days per week or 2340 hours per year
  - Case 2. Assume 12 hrs per day, 6 days per week or 3744 hours per year
- Simple Payback = Cost/Savings
  - Case 1. = .66 years or ~ 7 months
  - Case 2. = .43 years or ~ 5 months

Figure 1: First vs Operating Costs (hypothetical)
What's good for first costs tends to be bad for operating costs (i.e., efficiency usually costs more)



Life-Cycle Cost (LCC)

- Total cost of owning, operating, and maintaining a system over its useful life.
- Costs are adjusted for time value of money.
- Alternative with the lowest life-cycle cost is the best.

Heating Unit Homework Example

- Compare first cost
- Compare efficiency
- Calculate energy consumption
- Convert energy units to dollars
- Calculate simple payback

Life-Cycle Cost

- LCC analysis mandated by Federal Govt. for new or existing buildings. (Federal Energy Management Improvement Act of 1988 renewed in 99 "Greening the Government through Efficient Energy Management")
- LCC nomenclature Standardized by FEMP

Time Value of Money

- Life-Cycle Cost considers the time value of money:
  - Inflation=
    - Erosion of future purchasing power
  - Opportunity Cost =
    - Forgone investment opportunities
    - Cost of borrowing capital

Energy Modeling & Economics

- eQuest – Energy Modeling
  - http://doe2.com/equest/index.html
  - Good for complex economic analyses that may involve "whole system" performance.
- MotorMaster 3+
  - http://www.energy.wsu.edu/cfdocs/mmdownload/register.cfm
  - Includes Economics for motor retrofits

Energy Modeling Components

- Set Objectives
- Site and Weather
- Building shell
- Operations & Scheduling
- Internal loads
- HVAC Equipment
- Utility Rates
- Economic Parameters

Advanced Sources

- "User-Friendly Life-cycle Costing"
  - Excel spreadsheet
  - www.doe2.com (Scroll down for different operating system formats)
  - "Glass Box" form of the FEMP Building Life-cycle Cost Program (BLCC)

IRR Example Spreadsheet

- Review lighting project
- Change cells to determine critical inputs

In Class Assignment

- In Groups of Two:
  - Select Project Type
  - Determine cost inputs
  - Determine savings inputs
  - List all assumptions
  - Start payback calculation
  - Discuss with class