

ES 70 Introduction to Energy Management

Energy Economics Part 2

Scott Gould
Instructor

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"

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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

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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

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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

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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

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Heating Unit Homework Example

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

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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.

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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

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Life-Cycle Cost Definitions

- First Costs
 - Design
 - Construction
- Recurring Costs
 - Annual
 - Utilities
 - Maintenance
 - Non-Annual
 - Replacements

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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

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Energy Modeling Components

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

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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

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LCCA Goals & Benefits

•Goals

Evaluate economic performance over building life

Balance initial investment (first costs) with long term ownership expense

•Benefits

Over a building's life, the present value of maintenance, operations, and utility costs are nearly as great as the initial project costs

Designing buildings with ownership costs in mind can result in significant savings over the building's life

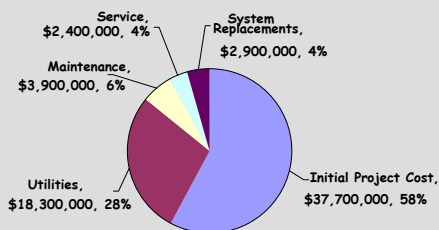
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Computer Science Building

30 Year Life-Cycle Cost



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LCCA & Sustainability

- LCCA is related to but not synonymous with sustainability
- LCCA is cost based rather than subjective (e.g., environmental impact, occupant comfort)
- Many sustainable based decisions result in lower costs

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LCCA Plan

- Operation Benchmarking
Develop operations, maintenance, and energy costs during project benchmarking
- Comparative Analysis
Conduct a series of analyses comparing total costs of various building systems options
The Project Team will assess up to 14 possible LCCA comparisons that fall into six general categories
 - Energy
 - Mechanical Systems
 - Electrical Systems
 - Building Envelope
 - Building Siting/Massing
 - Structural Systems

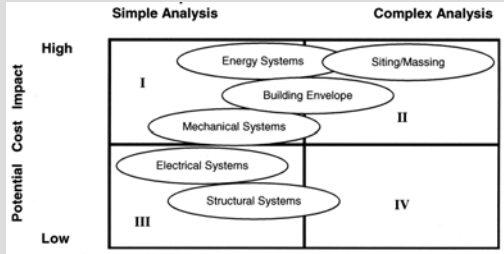
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LCCA and the Design Team

- Within each area, specific calculations compare life cycle costs of two or more options which address the same need
- For example, in analyzing mechanical distribution systems, the team might consider an overhead distribution versus an alternative underfloor approach
- The Project Team will prioritize from studies that will yield the highest potential return for the lowest potential cost

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Example: LCCA Decision Matrix



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Project Management & LCCA

- Scoping
 - Include LCCA costs in benchmark budget
- Feasibility/Programming
 - Develop operational budget
 - LCCA work session
 - LCCA decision matrix

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LCCA Process

- Step 1. Establish Objectives
- Step 2. Determine LCCA Metrics and Criteria
- Step 3. Identify and Develop Alternatives
- Step 4. Gather Cost Information
- Step 5. Perform LCCA Calculations

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Project Management & LCCA

- Schematic Design (SD)
 - Determine which LCCA studies to perform
 - Select cost-effective alternatives based on results
- Design Development (DD)
 - Review assumptions

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Project Management & LCCA

- Construction Documents
 - Confirm value engineering decisions with LCCA results
- Construction
 - Design team shares LCCA elements with construction team
 - Commissioning, testing,
- Closeout/Occupancy
 - Post occupancy evaluation
 - Validate LCCA outcomes and assumptions for next project

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HVAC Retrofit of an Existing Lab Building

- Project Description -Research Lab 71,000 square feet 800k \$/yr
- Objectives -Evaluation of a number of HVAC retrofit alternatives
- Alternatives to be Studied
- Variable (VAV) distribution system for non-lab air-volume area
 - VAV distribution for lab area
 - The above measures in combination
- Cost Information
- Detailed DOE-2 Energy Model was built and Base Model was calibrated to existing building utility data
 - Maintenance data was not included
 - Construction costs were provided by an HVAC contractor

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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)

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Class Objectives -- Review

- 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

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