FINANCIAL EVALUATION OF ENERGY SAVING PROJECTS: BUILDING THE BUSINESS CASE

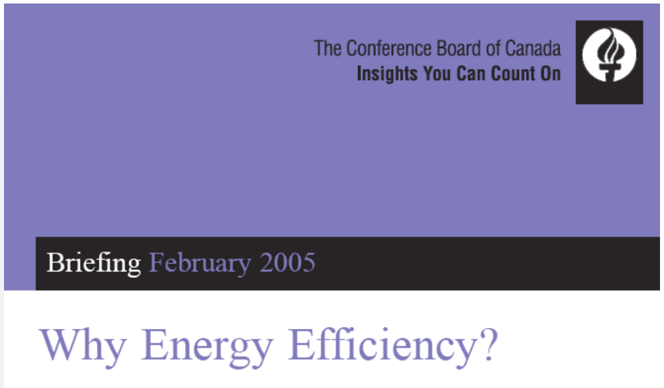
CFAA 2010 Canadian Rental Housing Conference

June 14, 2010

Presented by Robert Greenwald, PEng., MBA

President, Prism Engineering Ltd.

Speaking the Language of the CFO


The Conference Board of Canada
Insights You Can Count On

Briefing February 2005

Why Energy Efficiency?

"The business case for EE is a strong one. The surprise is that more firms are not adopting EE. Why not?

One obstacle appears to be the way in which the case for EE is being communicated. Engineers and operations managers need to better motivate their executive team.

They must speak in the language of the Chief Financial Officer (CFO) and Chief Executive Officer (CEO), citing not just the costs, but the savings, the low financial risk, the decreased waste and the social benefits."

"Often energy efficiency investment decisions are based on simple financial metrics, such as simple payback, cost relative to budget or the building's pro forma. These analysis methods may be valuable, but they are not broad enough to provide sufficient information for the best decision making… Conversely, when return on investment, risk and time value of money are considered, often energy efficiency upgrades are shown to be very prudent."

- http://www.fmlink.com/ProfResources/Magazines/article.cgi?BOMA:boma061308.html

LET'S START WITH UNDERSTANDING BUSINESS CASE APPROVALS

Decision Points

- Pass Operational Review
- Pass Strategic Review
- Pass Financial Review

All leading to…

- The Capital Competition

Typical Questions – Operational

- Is there local support for the technology?
- Is the technology proven?
- What training is required?
- Do we have the internal expertise required?
- What impact will the project have on staffing?
- The are the environmental and safety implications

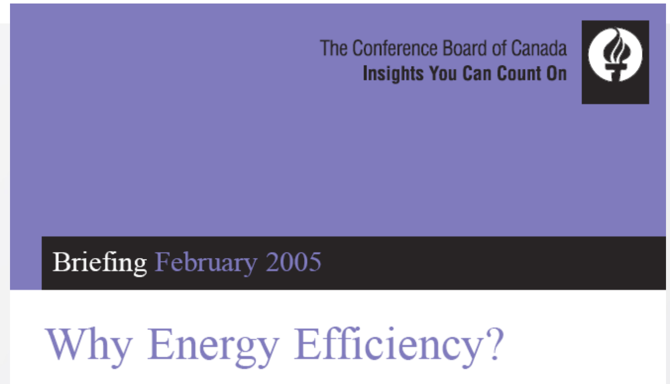
Typical Questions – Strategic

- How does this project fit with our mission?
- How disruptive will the project be to our operations?
- What is the impact of delaying for 1 year?
- What other options have been considered?
- How does this fit with our current priorities?

Typical Questions – Financial

- Are there hidden or additional costs?
- What are the benefits? Energy Savings?
- How realistic are the costs and savings projections?
- What financial impact will this have on other areas of our organization?
- How do you propose to finance the project?
- How quickly will we see benefits?

Financial Hurdles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Why Energy Efficiency?

"Aside from the easy "low-hanging fruit" many EE projects produce payback periods that are slightly longer than most financial officers prefer.

This simple investment criterion takes capital investment proposals off the executive agenda before they even appear.

However, the *risks of EE investments,* which are lower or non-existent compared to alternative investments, are neither well-quantified nor well-communicated to business leaders."

The Financial Analysis in a Business Case

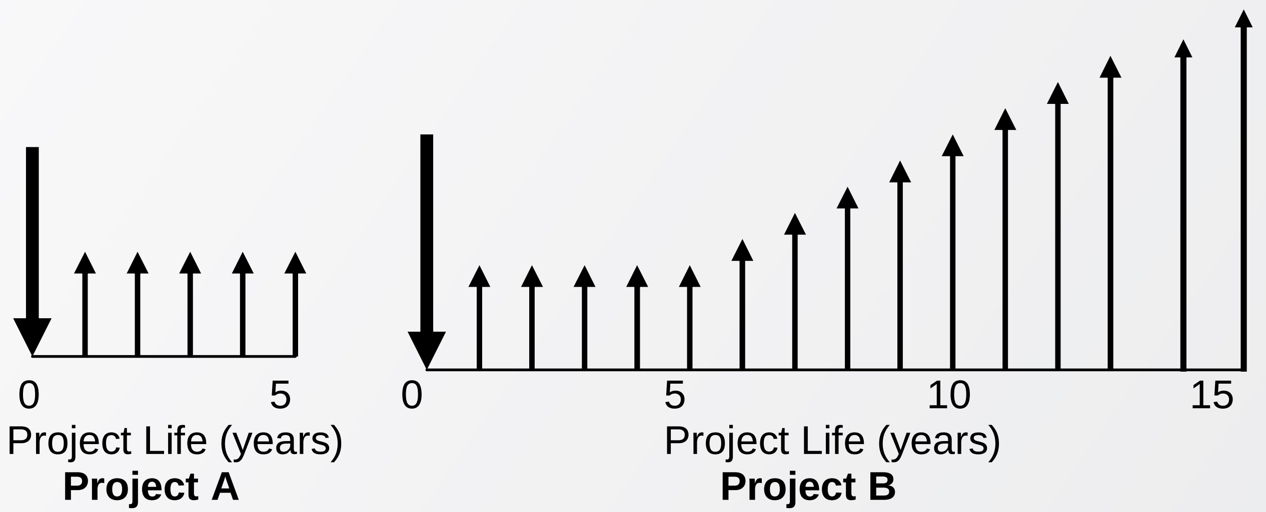
- Capital Required
- Cost Savings
- Simple payback
- Net Present Value (NPV)
- Internal rate of return (IRR)
- Sensitivity Analysis
- Impact on O&M (positive or negative)
- GHG credits
- Assumptions

Objectives of Investment Appraisal

- Which investments make the best use of available money?
- Ensure optimum benefits from investment
- Minimize the risk
- A basis for subsequent performance analysis

WHY NOT JUST USE SIMPLE PAYBACK?

Simple Payback…too simple?



Which project would you prefer?

What's Wrong with Simple Payback?

- Doesn't take into account
  - Ongoing savings after the payback period
  - The time value of money

- But, it's a useful preliminary indication of the merits of a project

NEED TO CONSIDER THE TIME VALUE OF MONEY

Time Value of Money

The time value of money needs to be considered as a dollar received *now is worth more* than same dollar received *in the future.*

Time Value of Money - Discount Factors

Discount Factors $1/(1 + i)^n$						
Year (n)	0	1	2	3	4	5
Discount Factor						
6%	1	0.942	0.888	0.840	0.792	0.747
10%	1	0.909	0.826	0.751	0.683	0.620
20%	1	0.833	0.694	0.579	0.482	0.402
30%	1	0.769	0.591	0.456	0.350	0.270
40%	1	0.714	0.510	0.364	0.260	0.186
45%	1	0.690	0.476	0.328	0.226	0.156
50%	1	0.666	0.444	0.297	0.198	0.132

Time Value of Money Example of Discounting

- What if we want to determine how much a $1,000 benefit in 30 years is worth to us today?
  - $1000 in “real” dollars (i.e., in dollars with today’s purchasing power)
  - Discount rate is 3%

Economic Analysis Example (continued)

- Present Value or PV tells us how much a future amount is worth today
- Plug values into discounting formula:

$$PV = \left(\frac{1}{(1+.03)^{30}} \right) \$1{,}000_{\ year\ 30}$$

- Do calculation:

$$PV = \$1{,}000 \text{ x } 0.41199 = \$412$$

Discount Rate Is Important

- Higher the discount rate, the lower the present value of a future dollar
- At 3%, $1,000 30 years from now is worth only $412 today

  …it is worth $231 at 5%

  …but only $57 at 10%
- Discount rate can influence project selection

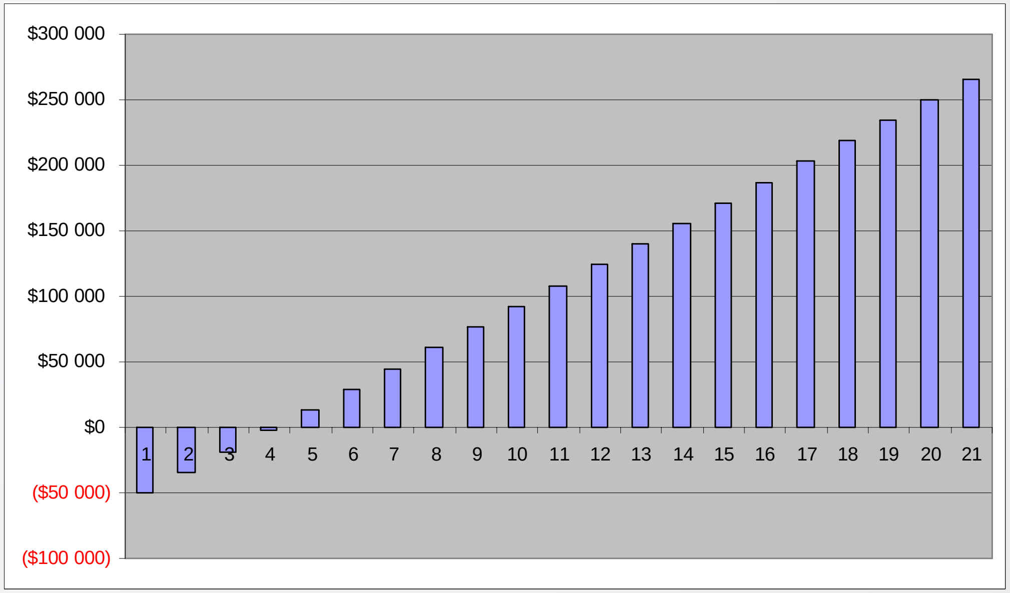
$10,000 Savings in the Future… How Much in my Pocket Today?

Year	Savings	2%	4%	6%	8%
1	$ 10,000.00	$ 9,803.92	$ 9,611.69	$ 9,423.22	$ 9,238.45
2	$ 10,000.00	$ 9,611.69	$ 9,238.45	$ 8,879.71	$ 8,534.90
3	$ 10,000.00	$ 9,423.22	$ 8,879.71	$ 8,367.55	$ 7,884.93
4	$ 10,000.00	$ 9,238.45	$ 8,534.90	$ 7,884.93	$ 7,284.46
5	$ 10,000.00	$ 9,057.31	$ 8,203.48	$ 7,430.15	$ 6,729.71
6	$ 10,000.00	$ 8,879.71	$ 7,884.93	$ 7,001.59	$ 6,217.21
7	$ 10,000.00	$ 8,705.60	$ 7,578.75	$ 6,597.76	$ 5,743.75
8	$ 10,000.00	$ 8,534.90	$ 7,284.46	$ 6,217.21	$ 5,306.33
9	$ 10,000.00	$ 8,367.55	$ 7,001.59	$ 5,858.62	$ 4,902.23
10	$ 10,000.00	$ 8,203.48	$ 6,729.71	$ 5,520.71	$ 4,528.90
11	$ 10,000.00	$ 8,042.63	$ 6,468.39	$ 5,202.29	$ 4,184.01
12	$ 10,000.00	$ 7,884.93	$ 6,217.21	$ 4,902.23	$ 3,865.38
13	$ 10,000.00	$ 7,730.33	$ 5,975.79	$ 4,619.48	$ 3,571.01
14	$ 10,000.00	$ 7,578.75	$ 5,743.75	$ 4,353.04	$ 3,299.06
15	$ 10,000.00	$ 7,430.15	$ 5,520.71	$ 4,101.97	$ 3,047.82
16	$ 10,000.00	$ 7,284.46	$ 5,306.33	$ 3,865.38	$ 2,815.72
17	$ 10,000.00	$ 7,141.63	$ 5,100.28	$ 3,642.43	$ 2,601.29
18	$ 10,000.00	$ 7,001.59	$ 4,902.23	$ 3,432.34	$ 2,403.19
19	$ 10,000.00	$ 6,864.31	$ 4,711.87	$ 3,234.37	$ 2,220.17
20	$ 10,000.00	$ 6,729.71	$ 4,528.90	$ 3,047.82	$ 2,051.10

HOW TO CALCULATE NPV AND IRR

The Net Present Value (NPV) Approach

- Basic and essential test method to evaluate projects among other available financial tests
- Considers financial impacts not revealed with the pay-back method
- Considers all relevant elements of projects - all variation of revenues, savings, and costs



Cumulative cash flow shown

Components Required to Calculate NPV

For well-defined design and technology alternatives:

- Total investment costs for each alternative including:
  - Initial investment costs
  - Major equipment residual market value
- All variations of revenues realized as a result of the investment
- All variations of expenses (savings or cost increases)
  - Replacement costs and major maintenance costs
  - OM&R costs including energy, regular and preventive scheduled maintenance
  - Income Taxes (when applicable)

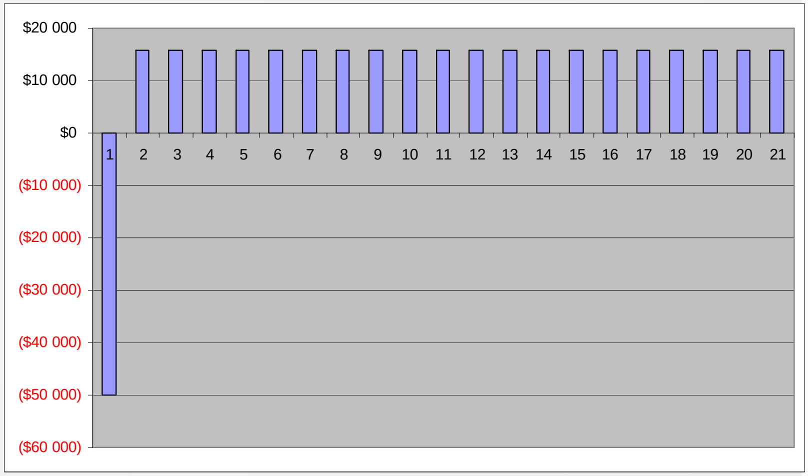
What Costs to Include

- Design, development, and engineering
- Initial capital investment and financing
- Operation, maintenance, and functional use
- Replacement
- Alteration, refurbishing, and improvement
- Salvage and retirement

Financial Criteria Details

- Discount Rate
  Use the owner's after tax weighted average cost of capital; it is specific to the organization and is computed as the average of all current short and long term financing sources
- Inflation or Escalation Rate
  Use cash flows in current dollars (increased by the inflation rate) and apply various inflation rates (could be different for maintenance, fuel, power…)
- Time Frame
  Assessed alternatives on the same time frame
- Risk
  Risk is generated by uncertainty. Use sensitivity analysis to compare alternative assumptions for your forecasts

Calculation Methodology



Computed as:

- Initial Investment

+ Present value (discounted) of the revenue flows

+ Present value of all the savings flows (Energy + Maintenance Costs + OM&R)

- Present Value of all the increase in costs flows (Energy + Maintenance Costs + OM&R)

+ Present Value of Residual Values

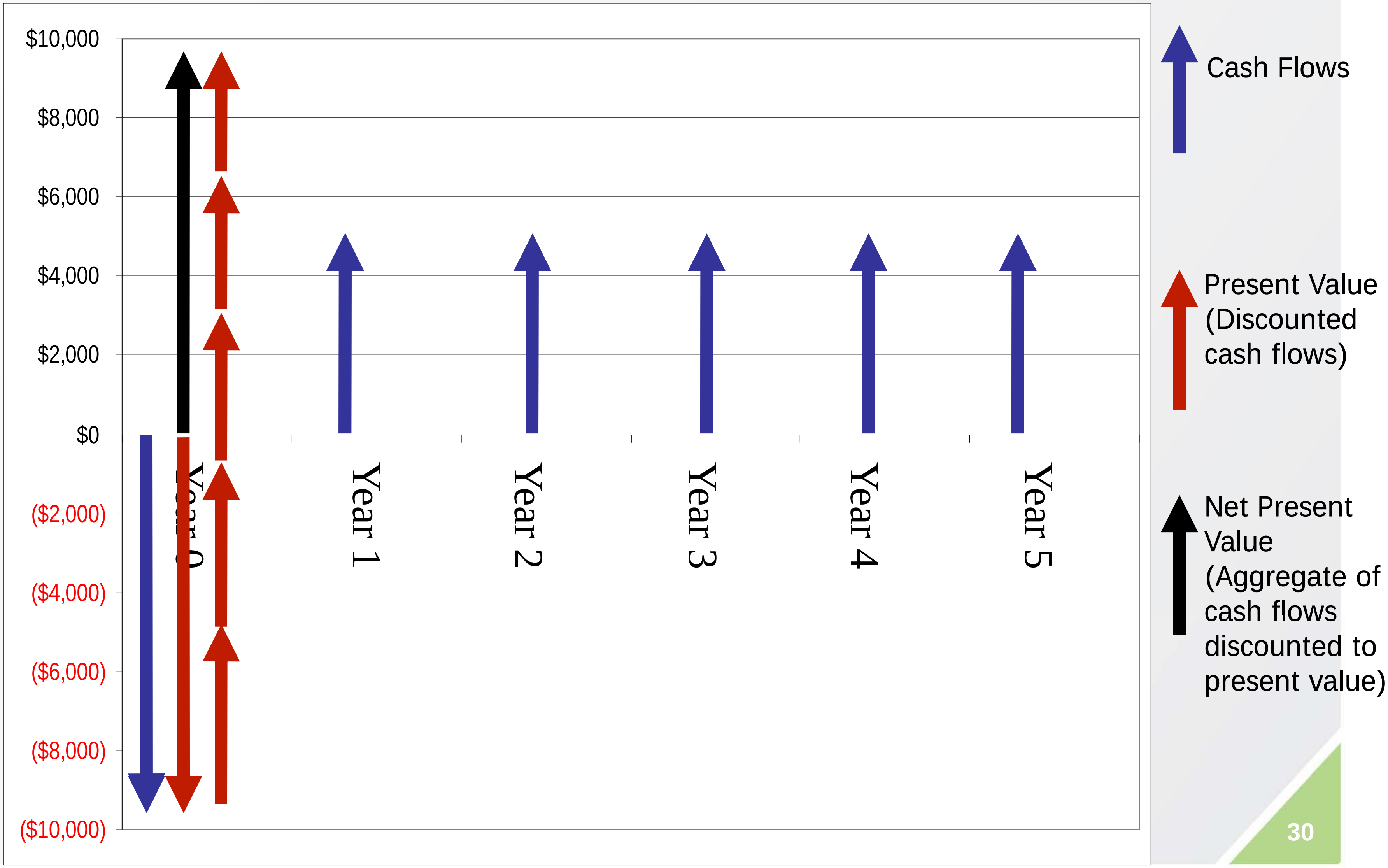
= **Net Present Value**

Cash Flow Example

Cash Flow Table for Purchase of new Boiler						
Capital Expenditure $100,000 Expected Savings $48,000			90% on delivery/commissioning, and 10% performance guarantee due at one year Half in first year, full amount in all remaining years			
(Values in $'000)						
Year	**0**	**1**	**2**	**3**	**4**	**5**
Costs	(90.0)	(10.0)	0	0	0	0
Savings	0	24.0	48.0	48.0	48.0	48.0
Net cash flow	(90.0)	14.0	48.0	48.0	48.0	48.0
Cumulative Project Value	(90.0)	(76.0)	(28.0)	20.0	68.0	116.0

Net Present Value

NPV Calculation						
Year	0	1	2	3	4	5
Net cash flow ($000s)	(90.0)	14.0	48.0	48.0	48.0	48.0
The discounted cash flow at 10% can be found as follows:						
Year 0	1 x (90.0)	= (90.0)				
Year 1	0.909 x 14.0	= 12.73				
Year 2	0.826 x 48.0	= 39.65				
Year 3	0.751 x 48.0	= 36.05				
Year 4	0.683 x 48.0	= 32.78				
Year 5	0.620 x 48.0	= 29.76				
NPV = the sum of all these values = 60.97 (vs. cumulative project value = 116.0)						


$10,000
$8,000
$6,000
$4,000
$2,000
$0
($2,000)
($4,000)
($6,000)
($8,000)
($10,000)
Year 0
Year 1
Year 2
Year 3
Year 4
Year 5
Cash Flows
Present Value (Discounted cash flows)
Net Present Value (Aggregate of cash flows discounted to present value)

Why NPV?

A capital expenditure can not only be looked at on a one time basis.

One needs to consider all revenues and expenses related to that decision over the life of the equipment.

Internal Rate of Return (IRR)

The project rate of return that makes the present value of all future cash flows equal to the initial investment value of the project.

Also known as "project yield".

Discount	NPV	IRR
10%	$61,048.67	30.37%
20%	$25,216.05	
25%	$11,885.44	
30%	$753.50	
31%	-$1,250.47	
35%	-$8,627.04	

WHAT IS LIFE CYCLE COSTING…

- and how is it different from NPV

Basically…

- Pay now or pay later

Life Cycle Costing (LCC) Defined

- The total discounted dollar cost of owning, operating, maintaining, and disposing of a building or a building system (NIST Handbook 135)

- Life Cycle Costing is a process to determine the sum of all the costs associated with an asset or part thereof, including acquisition, installation, operation, maintenance, refurbishment and disposal costs. It is therefore pivotal to the asset management process. (NSW Government)

- Life Cycle Costing (LCC) is a methodology to evaluate the economic performance of investments in building and building systems. www.lifecycle.org

Applications of LCC

- Asset Management
- Facility Management
- Value Engineering
- Sustainable Design/Integrated Design Process

Some LCC Applications for Sustainable Design

- Analyzing active versus passive system tradeoffs: passive cooling/ventilation
- Daylighting systems versus thermal loads
- Application of renewable energy systems
- Ultra low flow water systems

LCC and NPV…the ABCs

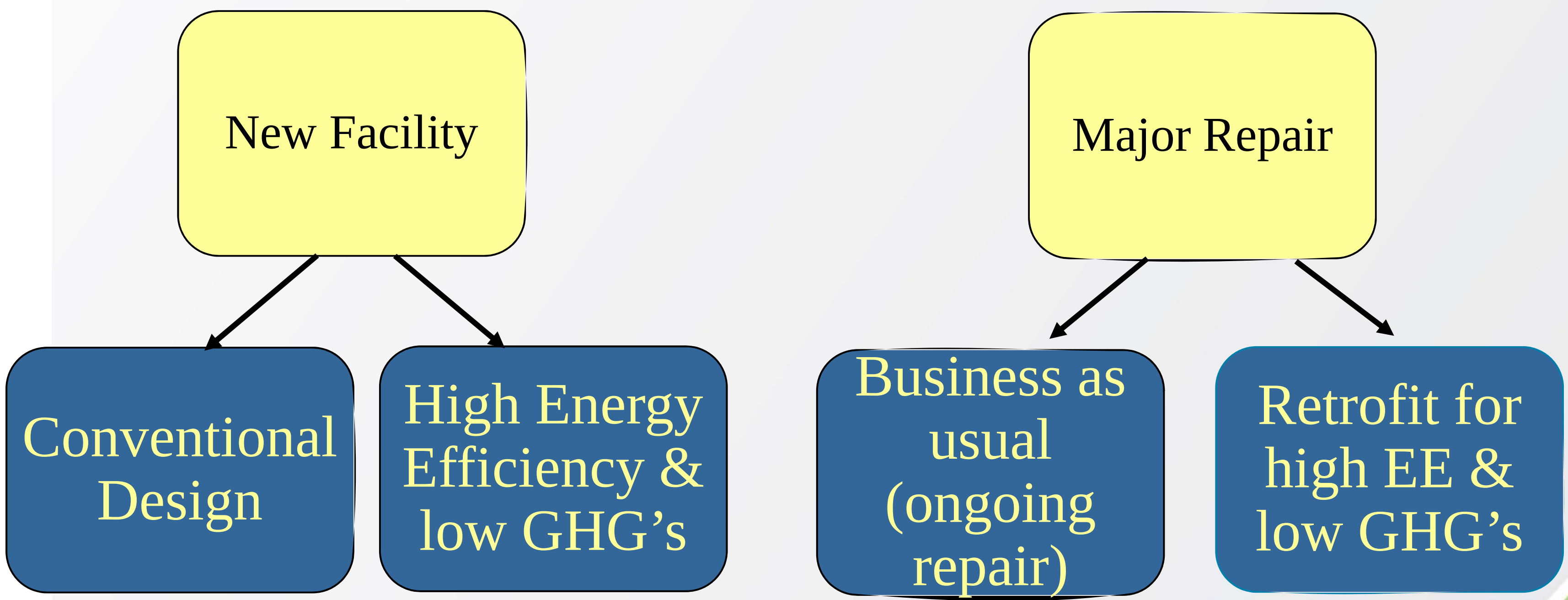
- Both look at the COSTs and financial BENEFITS over the life of the product, installation or project
- Both can be used interchangeably
- LCC is typically used for negative NPV projects (what is the COST over the life)
- NPV is typically used for investments where the benefits are greater than the costs
- Better to have
  - High NPV
  - Low LCC

CASE STUDIES

Options to be Considered

The financial analysis is primarily a way of discriminating between options. It is a ranking tool.

Options to consider are generally :



BC Housing - Process

By Prism

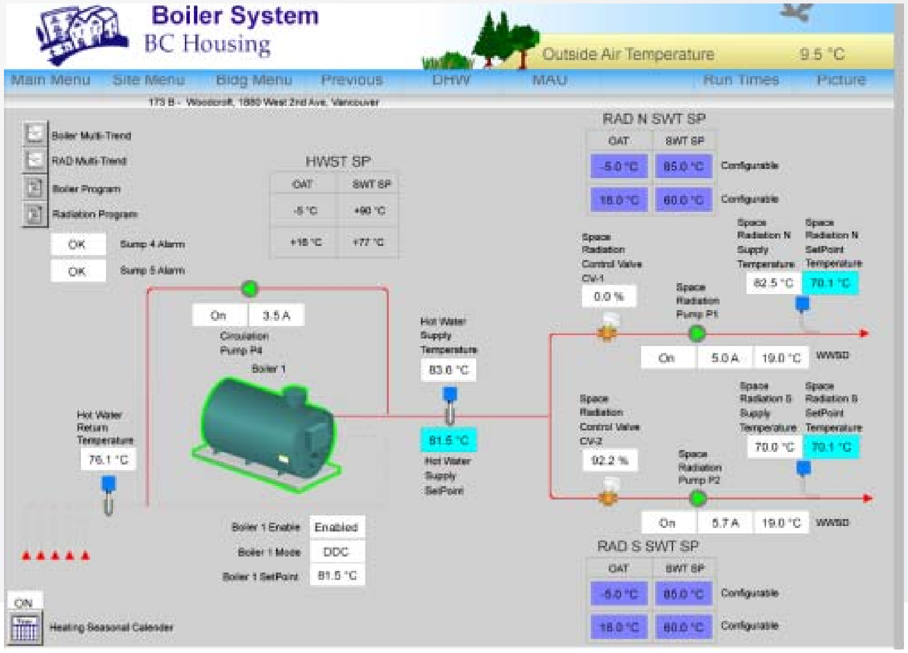
1. Screening Audit (100 sites)
2. Pilot Detailed Audits and Implementation (13 Sites)
3. Detailed Audits (20 Sites)

By Others

4. Energy Performance Contracts or EPC (> 100 sites)

Pilot Overview

- 5 Directly Managed Sites
- 8 Non-Profit Sites



Typical Measures

- M1 Boiler Replacement: Install High Efficiency Boilers
- M2 Heating Plant Upgrades: Update Burner Controls
- M3 DHW Plant Upgrades including solar heating pilot (1 site)
- M4 Piping Insulation
- M5 Update Controls: Add DDC
- M6 Adjust Setpoints: Outside Air Reset
- M7 Suite Temperature Control: Zone Valves
- M8 Time Schedule Make-Up Air
- M9 Install Low Flow Fixtures
- M10 Building Envelope Improvements: Windows
- M11 Energy Efficient Lighting: Common Areas
- M12 Energy Efficient Lighting: Suites

Savings and Financial Summary
5 Directly Managed Sites

Energy Savings and Budget Cost By Measures

Measure Code	Savings			Budget Costs	Engineering	Contingency	Total Costs	Simple Payback
	kWh	GJ	$	$	$	$	$	Years
M1		6,713[1]	$ 72,009	572,795	$ 85,919	$ 28,640	$ 687,354	9.5
M2								
M3		572	$ 6,131	95,296	$ 7,541	$ 4,765	$ 107,602	17.5
M4		137	$ 1,472	4,708	$ 706	$ 235	$ 5,650	3.8
M5		-	$ -	10,700[2]	$ 1,605	$ 535	$ 12,840	
M6		1,256	$ 13,471	42,780	$ 6,417	$ 2,139	$ 51,336	3.8
M7								
M8		238	$ 2,554	5,350	$ 803	$ 268	$ 6,420	2.5
M9		1,222	$ 13,106	$ 45,154	$ 6,773	$ 2,258	$ 54,185	4.1
M10		1,245[3]	$ 13,351					
M11	169,270		$ 9,135	$ 75,864	$ 11,380	$ 3,793	$ 91,037	10.0
M12	336,746		$ 22,899	$ 129,646	$ 19,447	$ 6,482	$ 155,575	6.8
Summary	**506,016**	**11,383**	**$154,128**	**$ 982,293**	**$ 140,590**	**$ 49,115**	**$1,171,998**	**7.6**

Savings and Financial Summary
5 Directly Managed Sites

Energy Savings and Budget Cost By Measures Considering "Incremental Cost and Incentives"

Measure Code	Savings			Incremental Cost	Engineering	Contingency	Total Incremental Costs	Simple Payback	NPV 20 yr	IRR 20 yr
	kWh	GJ	$	$	$	$	$	Years		
M1		6,713	$ 72,009	$ 197,969	$ 34,195	$ 11,398	$ 243,563	3.4	$582,379	29.4%
M2										
M3		572	$ 6,131	$ 79,546	$ 7,541	$ 4,765	$ 91,852	15.0	($21,528)	2.9%
M4		137	$ 1,472	$ 4,708	$ 706	$ 235	$ 5,650	3.8	$11,236	25.8%
M5				$ 10,700	$ 1,605	$ 535	$ 12,840		($12,840)	
M6		1,256	$ 13,471	$ 42,780	$ 6,417	$ 2,139	$ 51,336	3.8	$103,172	26.0%
M7										
M8		238	$ 2,554	$ 5,350	$ 803	$ 268	$ 6,420	2.5	$22,869	39.7%
M9		1,222	$ 13,106	$ 45,154	$ 6,773	$ 2,258	$ 54,185	4.1	$96,138	23.9%
M10		1,245	$ 13,351						$153,137	
M11	169,270		$ 9,135	$ 69,795	$ 11,380	$ 3,793	$ 84,968	9.3	$19,807	8.7%
M12	336,746		$ 22,899	$ 119,274	$ 19,447	$ 6,482	$ 145,203	6.3	$117,443	14.8%
Summary	**506,016**	**11,383**	**$154,128**	**$ 575,276**	**$ 88,866**	**$ 31,873**	**$ 696,016**	**4.5**	**$1,071,515**	**21.7%**

Bentall IM - Process

1. Screening Audit - 18 sites
2. Detailed Audits - 7 sites
3. Business Case - 6 sites
4. Implementation - 6 sites
5. Follow up M&V - 4 sites

Typical Measures

- M1 - Install High Efficiency Boilers
- M2 - DHW Plant Retrofit
- M3 - Install Building Automation System
- M4 - Building Envelope Improvements
- M5 - Air Conditioning Chiller Replacement
- M6 - Variable Speed Drives
- M7 - Accurate Suite Temperature Control
- M8 - Energy Efficient Lighting and Controls
- M9 - Building Ventilation Controls
- M10 - Garage Energy Opportunities
- M11 - Indoor Pool Measures
- M12 - Laundry Room Measures
- M13 - Water Conservation

Savings and Financial Summary Bentall IM

Energy Savings and Budget Cost By Measures Considering “Incremental Cost”

Measure	Energy Cost Savings ($)	Capital Cost Estimate ($)	Capital Cost Estimate ($) Credit applied for heating plants	Simple Payback With Credit	NPV 20 yr	irr 20 yr
6 Locations	$ 337,000	$ 3,609,000	$ 1,959,000	5.8	$ 1,910,000	16.4%

SENSITIVITY ANALYSIS

Risk and Sensitivity Analysis Scenarios

- Pessimistic
  - e.g. much higher interest rates
- Realistic
  - Best guess
- Optimistic
  - e.g. much higher energy costs

Sample Building, Vancouver

Scenarios

- 10,15, 20 year measure life
- 0%, 2%, 4% utility rate escalation
- 4%, 6%, 8% discount rate

Could also consider

- Carbon tax
- Carbon credits
- Maintenance savings

THE IMPACT OF INCENTIVES

Impact of Incentives on the Business Case

- Sample Building
- NRCan $10/GJ (equivalent to $0.036/kWh)
- Terasen Gas estimated at $14,500 based on boiler incentive program
- BC Hydro estimated at $0.10/kWh

  (varies with measure and program)

Sample Building, Vancouver

Scenario	Capital Costs	Energy Savings	Simple Payback	NPV (20 years, 6%, 2.5% escalation)	IRR (20 years, 2.5% escalation)
Base Case	$265,700	$42,746	6.2	$331,616	17.5%
With Incentives	$190,343	$42,746	4.5	$406,974	24.5%
Change			-1.7	+$75,358	+7.0%

TOOLS AND CALCULATORS

Sample Spreadsheet Tools

- NRCan (Energy Savings Toolbox)
- DOE (Energy Star Value Calculator)
- The Building Upgrade Value Calculator (BUVC), developed as part of the BOMA Energy Efficiency Program (BEEP), estimates the financial impact of proposed energy efficiency projects.

Spreadsheet Tools

EMO Life Cycle Cash Flow Analysis

Base Financial Case

Costs for Period		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Capital Cost	$50,000										
Maintenance	$200	$204	$208	$212	$216	$221	$225	$230	$234	$239	$244
Asset depreciation											
Lease costs											
Taxes											
Insurance											
Labour											
Other											
Sub-total Costs	**$50,200**	**$204**	**$208**	**$212**	**$216**	**$221**	**$225**	**$230**	**$234**	**$239**	**$244**
Savings for Period											
Electricity	$10,500	$10,500	$10,500	$10,500	$10,500	$10,500	$10,500	$10,500	$10,500	$10,500	$10,500
Gas or Fuel	$5,535	$5,535	$5,535	$5,535	$5,535	$5,535	$5,535	$5,535	$5,535	$5,535	$5,535
Water											
Maintenance											
Taxes											
Insurance											
Labour											
GHG Factors											
Sub-total Savings	$16,035	$16,035	$16,035	$16,035	$16,035	$16,035	$16,035	$16,035	$16,035	$16,035	$16,035
Net Cash Flow	($34,165)	$15,831	$15,827	$15,823	$15,819	$15,814	$15,810	$15,805	$15,801	$15,796	$15,791
Net Project Value	**($34,165)**	**($18,334)**	**($2,507)**	**$13,316**	**$29,134**	**$44,948**	**$60,758**	**$76,563**	**$92,364**	**$108,160**	**$123,951**
Discount Rate	10.00%										
Discounted Cash Flow	($34,165)	$14,392	$13,080	$11,888	$10,804	$9,819	$8,924	$8,111	$7,371	$6,699	$6,088

Net Present Value (NPV) : $63,012 **Internal Rate of Return (IRR) : 45%**

download from NRCan, 10 copies today

An Energy Assessment Tool that Incorporates Financial Analysis

- RETScreen® v4
- Download from www.retscreen.net

TRAINING

Online e-Energy Training www.bomalearning.com

BOMA Energy Training for BUILDING OPERATORS

BOMA - eEnergy Training

Assessing Costs and Benefits

Benefits	Costs
• Direct energy savings • Indirect energy savings • Comfort/productivity increases • Operating and maintenance cost reductions • Environmental impact reduction • O & M savings	• Direct implementation costs • Direct energy costs • Indirect energy costs • O & M cost increases

SUMMARY

Getting Approval

- We need to make the business case!
- It is not just our sector…this applies to other industries as well (see Health Care next slide)

Archive

Greening Operations Series: Making the Business Case for Energy Efficiency to your CFO

Feb 20 2009

Topic

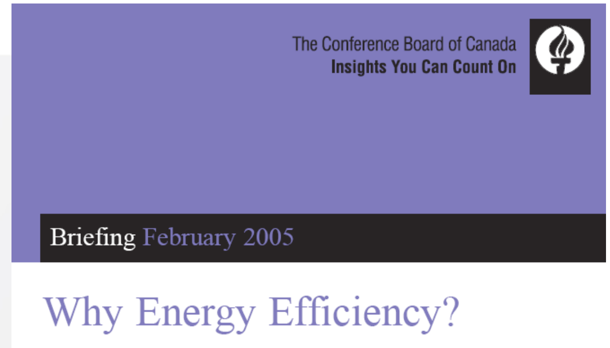
Facility managers can position energy as a controllable cost that, when well managed, can produce significant energy savings. In this presentation, you will hear from Skanda Skandaverl, Director of Facilities Management at Lawrence Memorial Hospital, who has effectively made the business case for energy performance investments by positioning energy as an investment-grade opportunity and by making an effective pitch that speaks in executive terms and aligns with the hospital's core mission – patient health.

Points To Include

Sixty-seven percent of healthcare CEOs list financial challenges as their number on concern and 75% of senior decision-makers believe that energy costs are the least controllable business cost. Meanwhile, U.S. hospitals are the second most energy-intensive commercial space type, making the impact of unstable energy prices and of savings from energy efficiency investments particularly significant.

Hospitals nationwide have been able to demonstrate that energy investments can create healthier hospitals – both for the environment and the bottom line. Facility managers can position energy as a controllable cost that, when well managed, can produce significant energy savings. In this presentation, you will hear from Skanda Skandaverl, Director of Facilities Management at Lawrence Memorial Hospital, who has effectively made the business case for energy performance investments by positioning energy as an investment-grade opportunity and by making an effective pitch that speaks in executive terms and aligns with the hospital's core mission – patient health. During a major

Beyond the Bottom Line



"Corporations face increased pressure to act in an accountable and socially responsible manner. More and more, a firm's reputation is becoming a discriminating factor for many investors and customers.

In 2002, sustainable development-based investing in Canada accounted for $51.4 billion of assets held in mutual funds. In addition to traditional business fundamentals, these funds consider a firm's environmental management practices, investments in communities, and shareholder advocacy. They screen for positive as well as negative company practices."

Blair W. Feltmate, Brian A. Schofield, and Ron W. Yachnin, Sustainable Development, Value Creation and the Capital Markets (Ottawa: The Conference Board of Canada, 2001).

Issues and Concepts

- Costs and benefits can be valued in dollars
- Project life cycle or system life is basis for comparison
- To be compared, dollars in different years must be "discounted" to their present value amounts
- Various inflation factors can be taken into account
- For each year, the difference between benefit and cost is discounted to the present
- The discounted net (benefit-cost) for all years is summed and compared to the initial investment

Summary

- NPV is an essential tool for decision making about energy management strategies
- NPV must not be used in a static fashion, but as an exploratory tool with sensitivity analysis
- Selection of discount rate and inflation factors is the key to a good NPV analysis

THANK YOU!

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