MARCH 8, 2024

Energy Management and Efficient Electrification Series for Ontario Municipalities

Financial Analysis for Energy Projects: Part One

Presented by Stephen Dixon and Christian Tham

Agenda

1. Definition of a financial analysis for an energy project
2. Essential formulas
3. Example of a financial analysis
4. Financial analysis in RETScreen
5. Life cycle cost analysis

Financial analysis 101

What is a financial analysis for an energy project ?

Financial analysis of an energy project involves the **evaluation** and **assessment** of the **economic viability and profitability** of that project. This analysis aims to provide a comprehensive understanding of the financial aspects associated with the project.

Here are key components typically included in a financial analysis of an energy project:

- **Cost estimation**
- **Revenue projections**
- **Cash flow analysis**
- **Return on investment**
- **Payback period**
- **Net present value**
- **Internal rate of return**

What information do we need?

Capital Cost
- One time or phased (re-fit)

Savings
- Energy & other

Time Horizon
- The period over which the project will deliver value

Discount rate
- Minimum rate of return required by investor
- Weighted average cost of capital
- Higher risk tends to increase discount rate.

Inflation Rate
- Energy & other

Essential formulas

- Conventionally future amounts are compared (apples to apples) with Present Value

$$Present\ Value = \frac{Future\ Amount}{(1 + Discount\ Rate)^{years}}$$

- Future savings are typically determined by inflating present savings

$$Future\ Amount = Present\ Savings\ (1 + Inflation\ Rate)^{years}$$

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Results formulas

- Net Present Value (NPV)

$$Sum\ of\ the\ PV\ of\ Cash\ Inflows\ (Savings)\ -\ PV\ of\ Cash\ Outflows\ (Investment)$$

- Savings to Investment Ratio (SIR)

$$\frac{Sum\ of\ the\ PV\ of\ Cash\ Inflows\ (Savings)}{PV\ of\ Cash\ Outflows\ (Investment)}$$

- Internal Rate of Return (IRR)
  - The discount rate that makes the NPV zero.
  - In simple terms – similar to an effective interest rate on an investment
  - Complex spreadsheet function for calculation.

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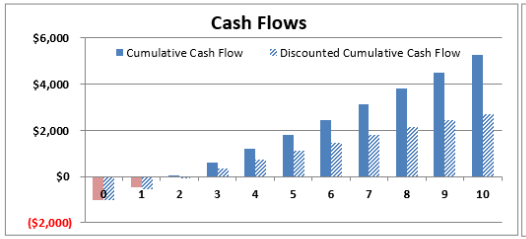
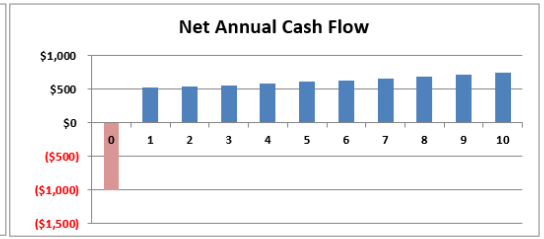
Let's walkthrough a financial analysis

Energy Project Life Cycle Cash Flow Analysis

Year of Project		0	1	2	3	4	5	6	7	8	9	10
Project Costs		$1,000										
Inflation Rate	4.0%											
Annual Project Savings		$500	$500	$500	$500	$500	$500	$500	$500	$500	$500	$500
Savings with Inflation			$520	$541	$562	$585	$608	$633	$658	$684	$712	$740
Net Cash Flow		($1,000)	$520	$541	$562	$585	$608	$633	$658	$684	$712	$740
Cumulative Cash Flow		($1,000)	($480)	$61	$623	$1,208	$1,816	$2,449	$3,107	$3,791	$4,503	$5,243
Discount Rate	10.0%											
Present Value (PV) of Net Cash Flow		($1,000)	$473	$447	$423	$400	$378	$357	$338	$319	$302	$285
Cumulative PV of Net Cash Flow		($1,000)	($527)	($80)	$342	$742	$1,119	$1,477	$1,814	$2,133	$2,435	$2,721

Financial Metrics		Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Simple Payback	2.0 yrs										
Internal Rate of Return	IRR	-48.0%	4.0%	28.3%	40.3%	46.7%	50.3%	52.4%	53.7%	54.5%	55.0%
Modified Internal Rate of Return	MIRR	-48.0%	5.5%	21.3%	26.4%	27.8%	27.9%	27.5%	26.9%	26.2%	25.4%
Net Present Value	NPV	($527)	($80)	$342	$742	$1,119	$1,477	$1,814	$2,133	$2,435	$2,721
Savings to Investment Ratio	SIR	0.5	0.9	1.3	1.7	2.1	2.5	2.8	3.1	3.4	3.7





Financing Rate (for MIRR)	10.0%
Re-Investment Rate (for MIRR)	10.0%

Costs & savings (inflated)

Year of Project		0	1	2	3
Project Costs		$1,000			
Inflation Rate	4.0%				
Annual Project Savings		$500	$500	$500	$500

Future amount = Present savings (1+ inflation rate)^{years}

Year of Project		0	1	2	3
Project Costs		$1,000			
Inflation Rate	4.0%				
Annual Project Savings		$500	$500	$500	$500
Savings with Inflation			$520	$541	$562

Present value of net cash flow

Year of Project		0	1	2	3
Project Costs		$1,000			
Inflation Rate	4.0%				
Annual Project Savings		$500	$500	$500	$500
Savings with Inflation			$520	$541	$562
Net Cash Flow		($1,000)	$520	$541	$562

$$\text{Present value} = \frac{\text{Future amount}}{(1+\text{Discount rate})^{\text{years}}}$$

Discount Rate	10.0%				
Present Value (PV) of Net Cash Flow		($1,000)	$473	$447	$423
Cumulative PV of Net Cash Flow		($1,000)	($527)	($80)	$342

Net present value (cumulative discounted cash flow)

Cumulative Cash Flow		($1,000)	($480)	$61	$623
Discount Rate	10.0%				
Present Value (PV) of Net Cash Flow		($1,000)	$473	$447	$423
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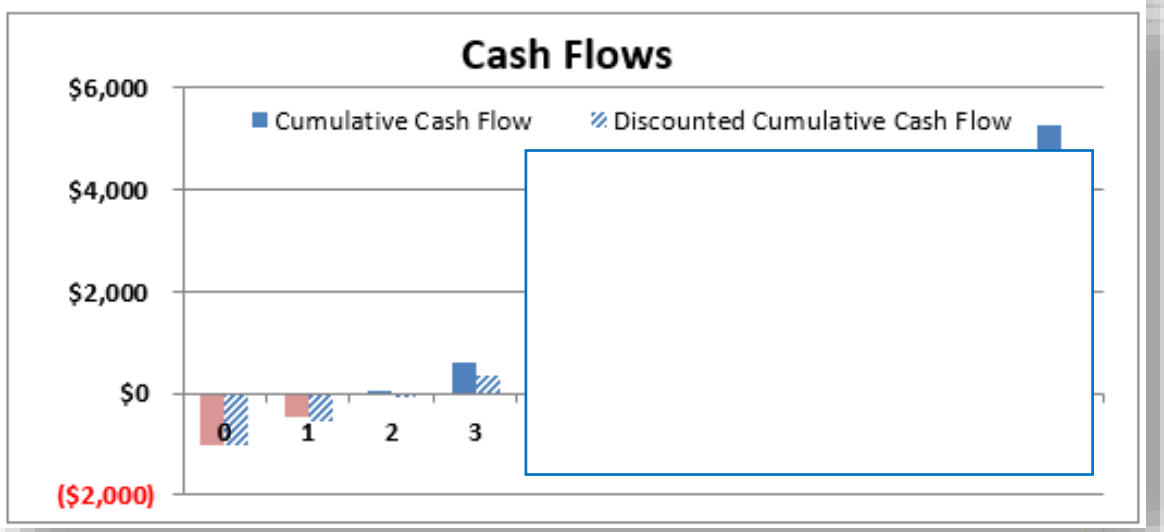
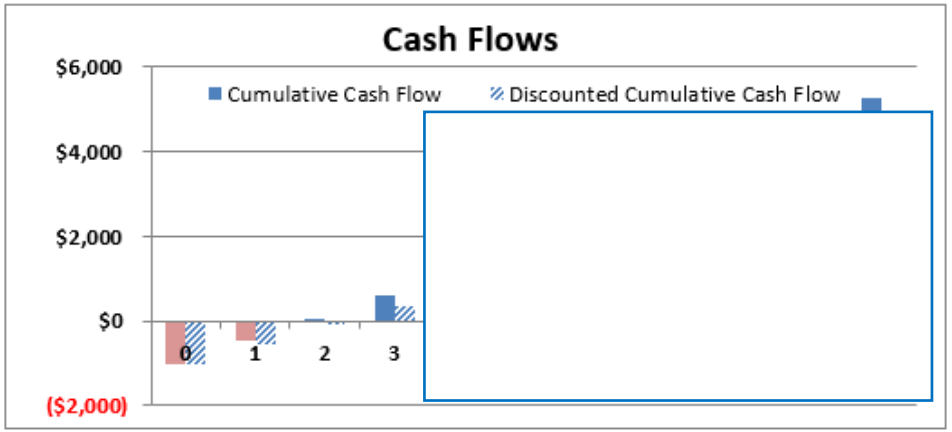


Financial metrics (better & common)

Financial Metrics		Year 1	Year 2	Year 3
Simple Payback	2.0 yrs			
Internal Rate of Return	IRR	-48.0%	4.0%	28.3%
Modified Internal Rate of Return	MIRR	-48.0%	5.5%	21.3%
Net Present Value	NPV	($527)	($80)	$342
Savings to Investment Ratio	SIR	0.5	0.9	1.3



Now let's stretch the horizon!

Financial Metrics		Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Simple Payback	2.0 yrs										
Internal Rate of Return	IRR	-48.0%	4.0%	28.3%	40.3%	46.7%	50.3%	52.4%	53.7%	54.5%	55.0%
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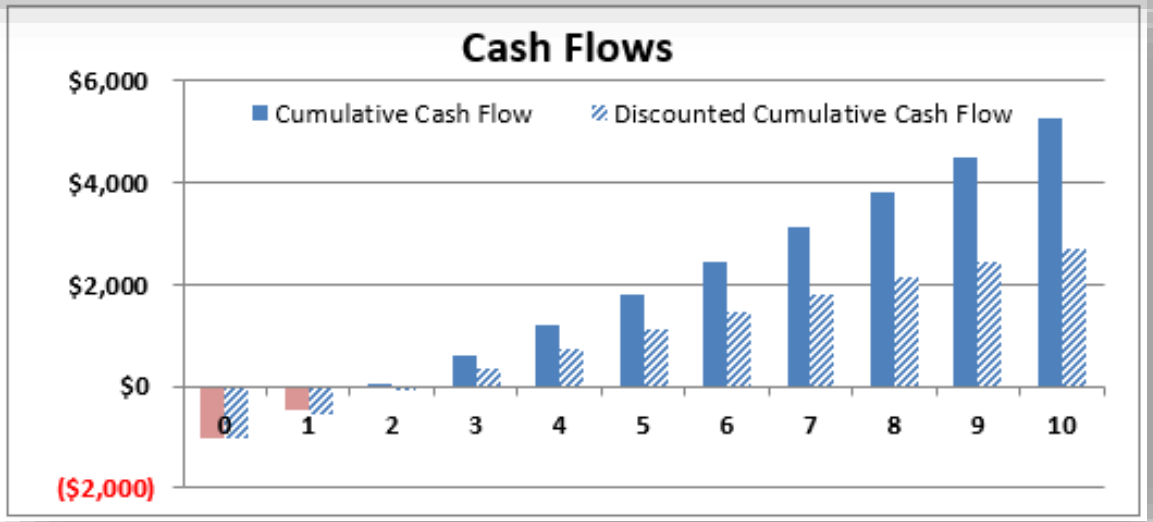

The whole picture

Energy Project Life Cycle Cash Flow Analysis

Year of Project	0	1	2	3	4	5	6	7	8	9	10
Project Costs	$1,000										
Inflation Rate 4.0%											
Annual Project Savings	$500	$500	$500	$500	$500	$500	$500	$500	$500	$500	$500
Savings with Inflation		$520	$541	$562	$585	$608	$633	$658	$684	$712	$740
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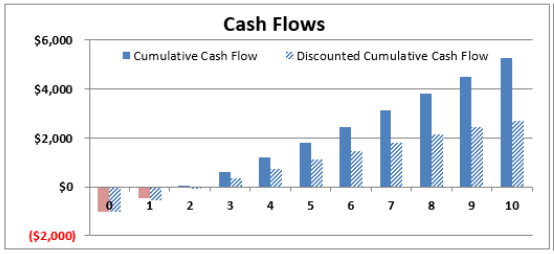

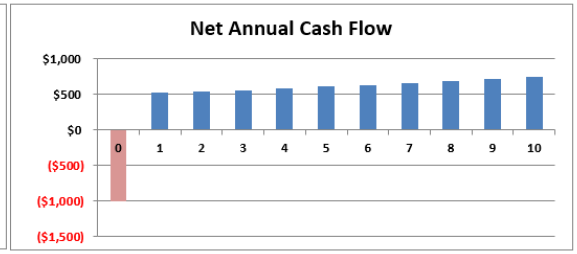

Financing Rate (for MIRR)	10.0%
Re-Investment Rate (for MIRR)	10.0%

RETScreen Expert demonstration

What is RETScreen Expert?

- Software developed by NRCan to analyze efficiency scenarios
- Decision support tool
    - Enables low-carbon planning, implementation, monitoring and reporting.
- Demonstration related to LCC and net zero

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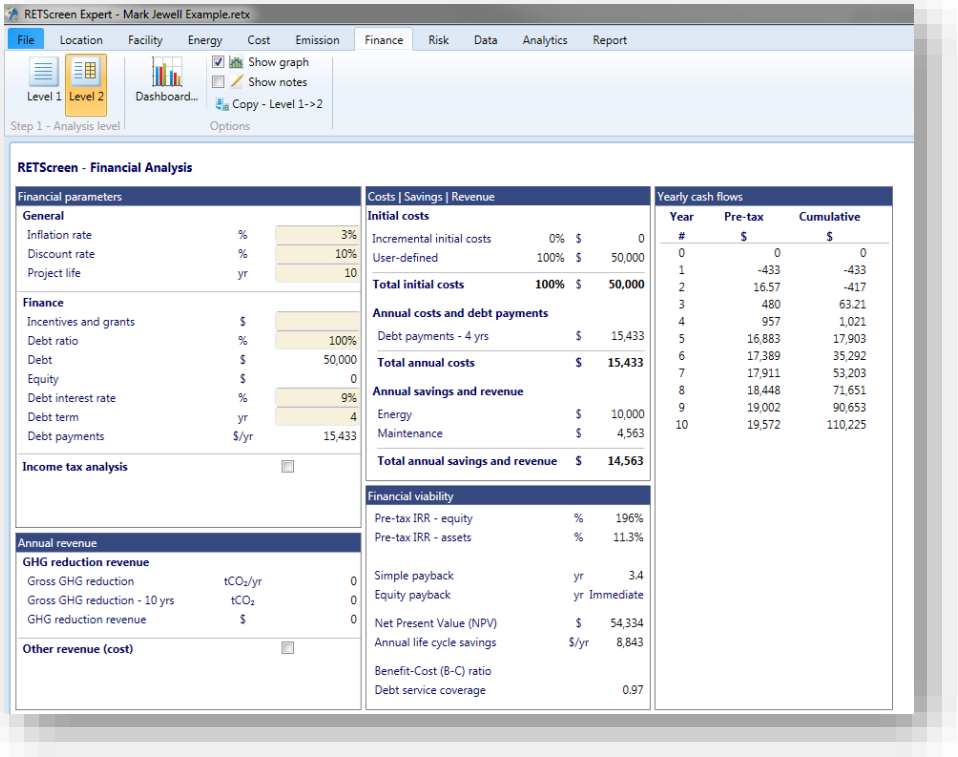
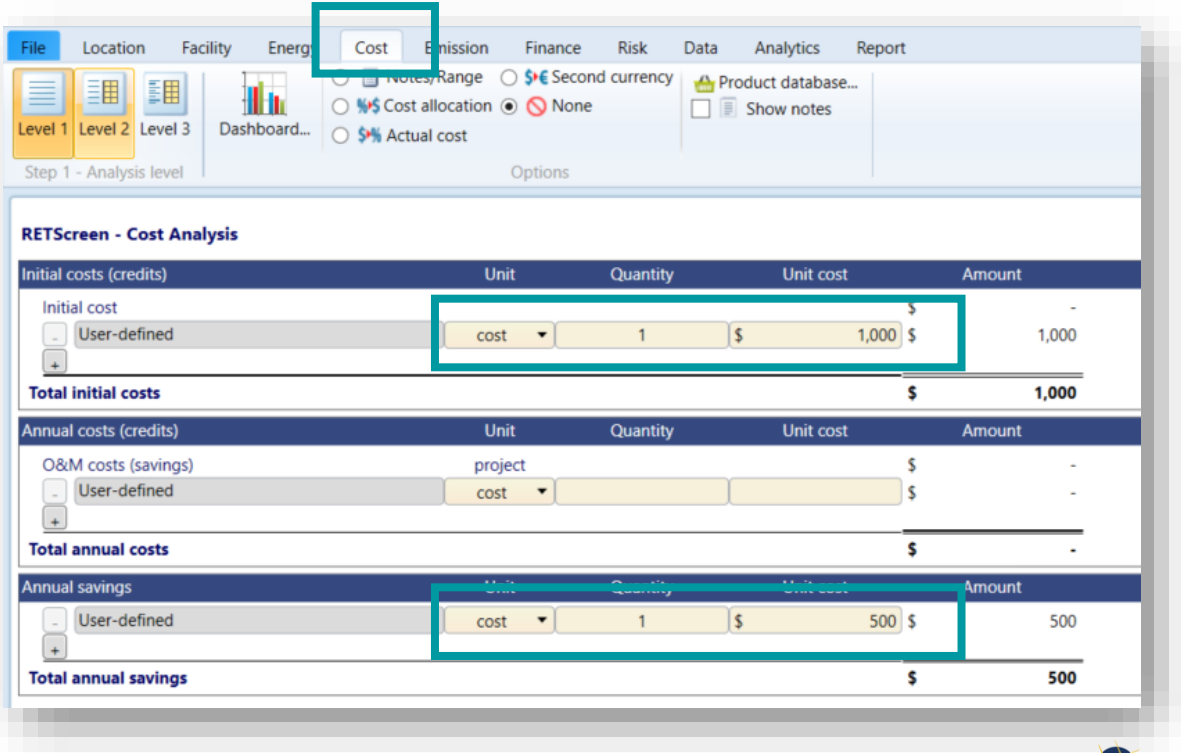
Financial analysis in RETScreen

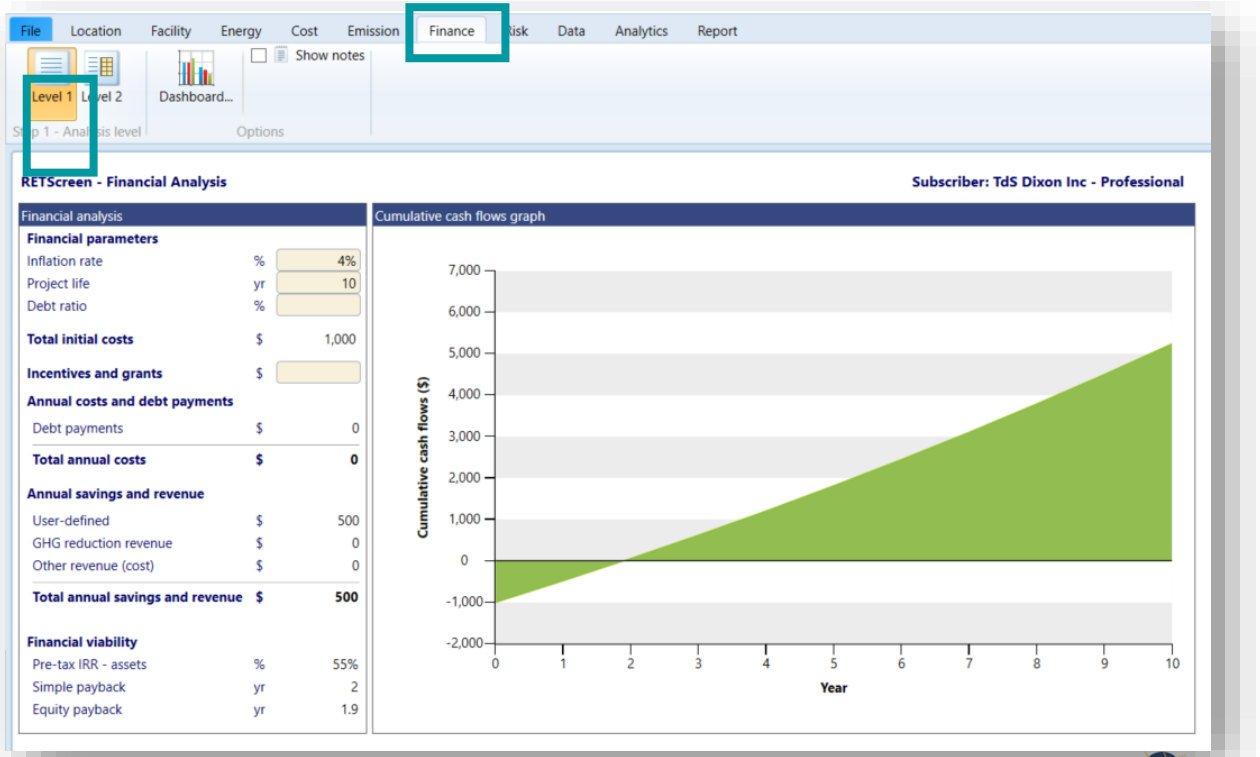


Entering cost & savings into RETScreen expert



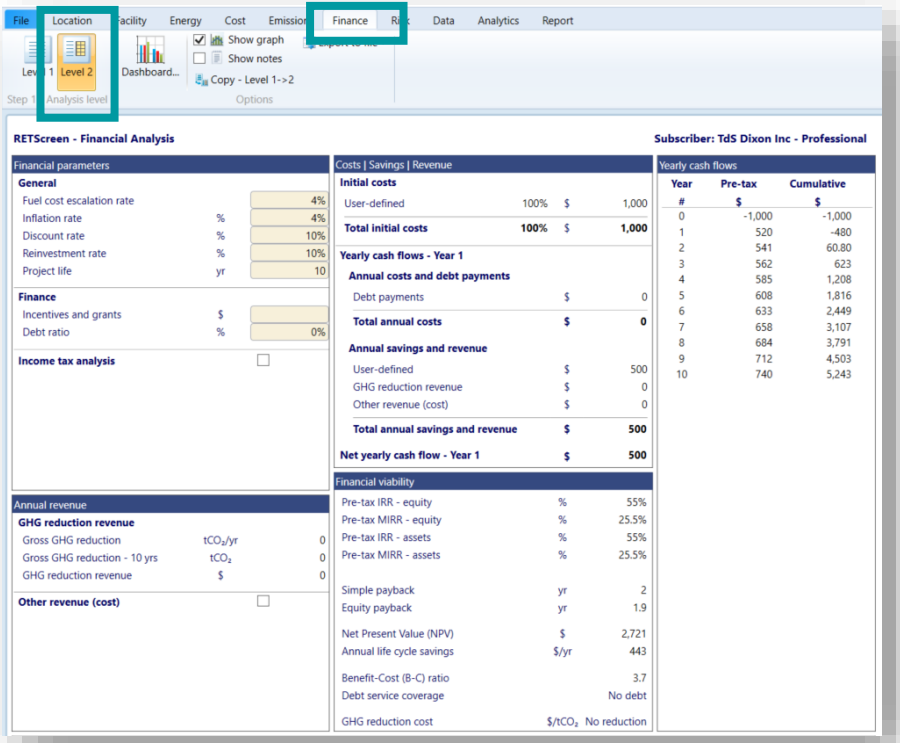
LEVEL 1 Financial analysis

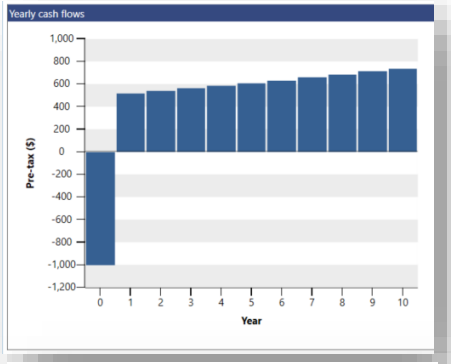
Entering values to match spreadsheet

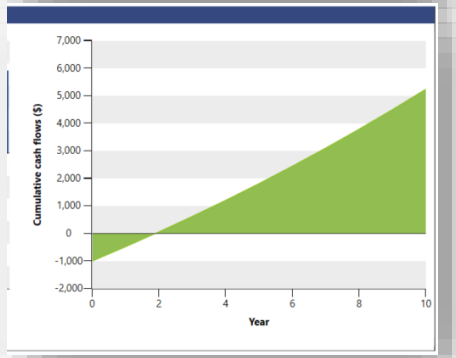


LEVEL 2 Financial analysis

Entering values to match spreadsheet

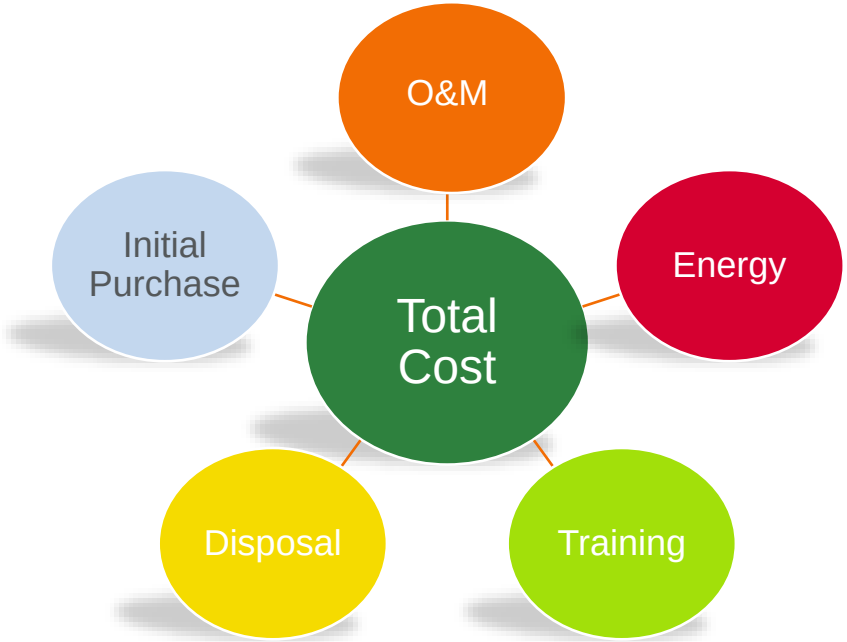






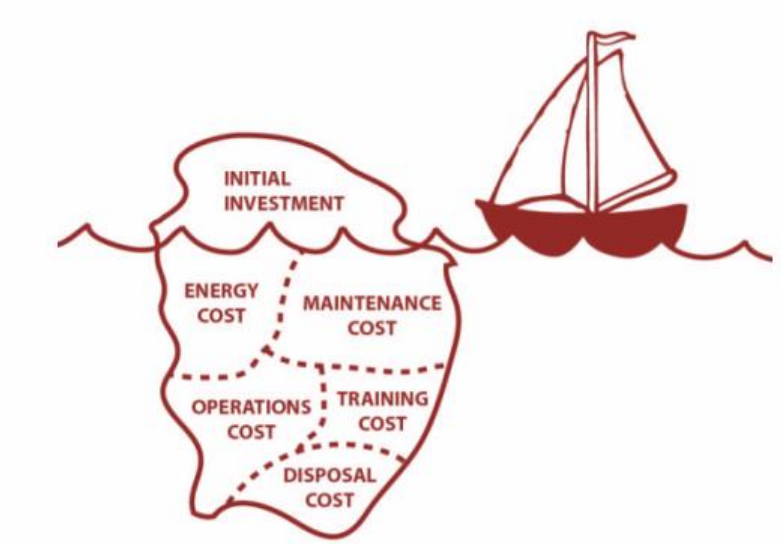
What is life-cycle costing?

What is life cycle costing (LCC)?



Life cycle cost analysis (LCCA)

- A method for assessing the total cost of ownership.
- Accounts for all costs of acquiring, owning, and disposing of a piece of equipment or system.
- Especially useful when project alternatives fulfill the same performance requirements:
  - But differ with respect to initial costs and operating costs,
  - And have to be compared in order to select the one that maximizes net savings



[https://www.wbdg.org/resources/lcca.php]

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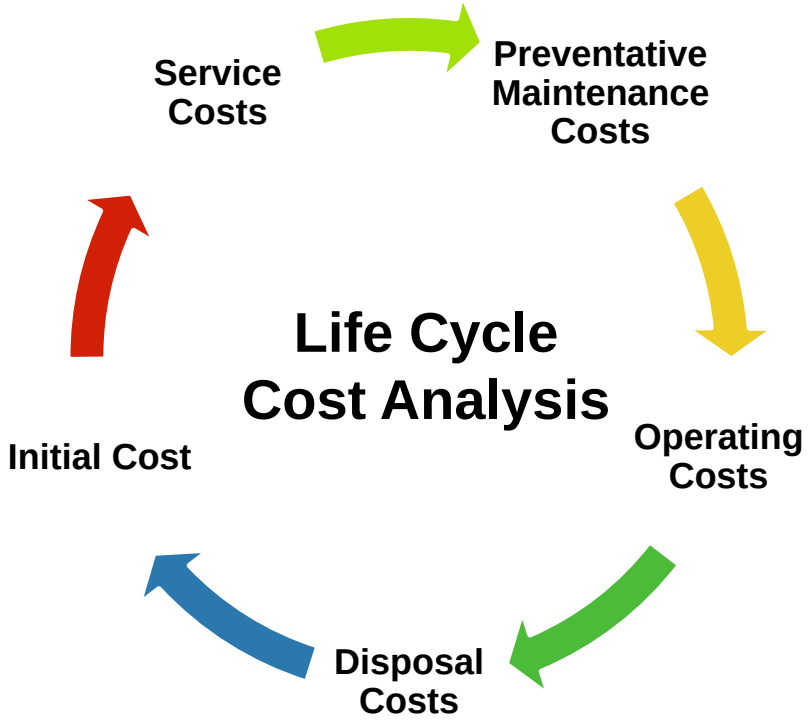
Where is LCC being used?

- Design environmentally and socially preferable tender specifications.
- Develop indicators on which bids will be appraised.
- Justify the purchase of environmentally and socially preferable alternatives
- Determine the "need to purchase" and subsequently discern between the outright purchase of an asset and the option of contracting services that would full this need.



[Adapted from: https://www.iisd.org/pdf/2009/life_cycle_costing.pdf]

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Life cycle costing methodology

LCC six step procedure

1. **Define the scope of the analysis**
   - Time Horizon
   - Equipment/System/Building/Site/Portfolio

2. **Identify relevant cost components**
   - Initial
   - Energy
   - Maintenance
   - Disposal
   - Other

3. **Gather data and perform analysis**

Kawauchi, Y., & Rausand, M. (1999). Life cycle cost (LCC) analysis in oil and chemical process industries.

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LCC six step procedure

4. **Calculate key financial indicators**
   - Net Present Value
   - Total Cost

5. **Perform a risk and uncertainty analysis**
   - What if inputs vary?

6. **Take the best decision**

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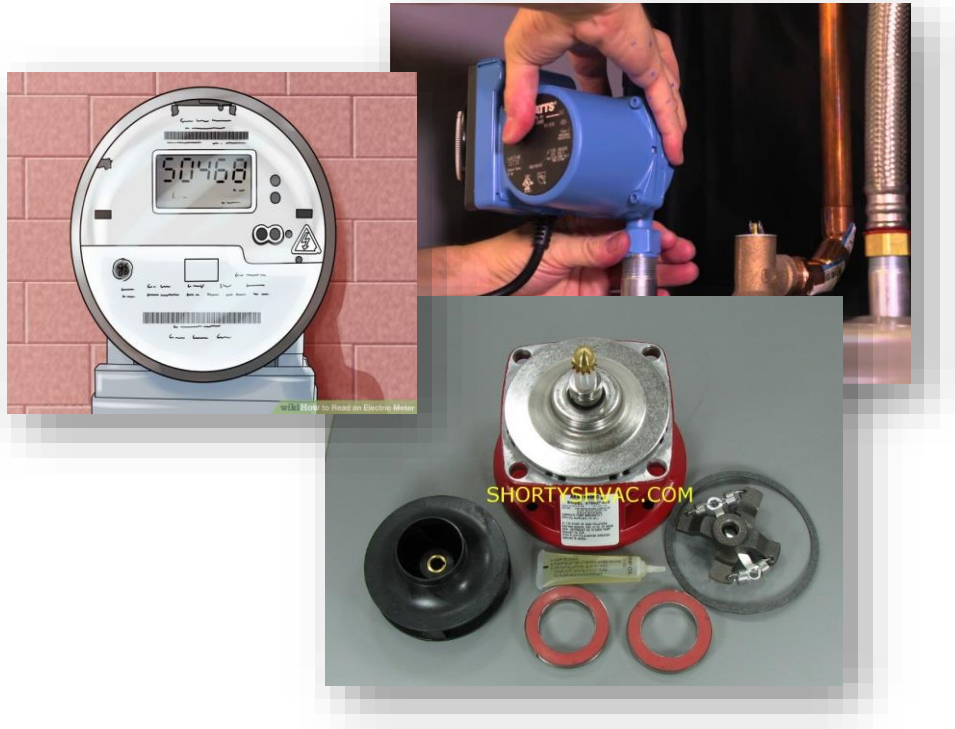
1. Define scope of analysis

- Hot water circulator pump in heating system
- Pump is at end of useful life
- Maintenance costs are significant
- Investigation reveals a significant energy savings potential
- Time horizon selected based on asset life etc. (example: 30 years)

2. Identify relevant cost components

- Initial Cost
- Maintenance Cost
- Energy Cost
  - Consumption x Price
  - Consumption = Power x Time



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3. Gather data and perform analysis

- Option A
  - Initial Cost = $2,000
  - Maintenance Cost of $500 every 2 years
  - Annual energy consumption of 5,000 kWh/yr
- Option B
  - Initial Cost = $2,500
  - Maintenance Cost of $375 every 3 years
  - Annual energy consumption of 4,000 kWh/yr
- Option C
  - Initial Cost = $3,000
  - Maintenance Cost of $250 every 4 years
  - Annual energy consumption of 3,000 kWh/yr

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Life cycle cost analysis

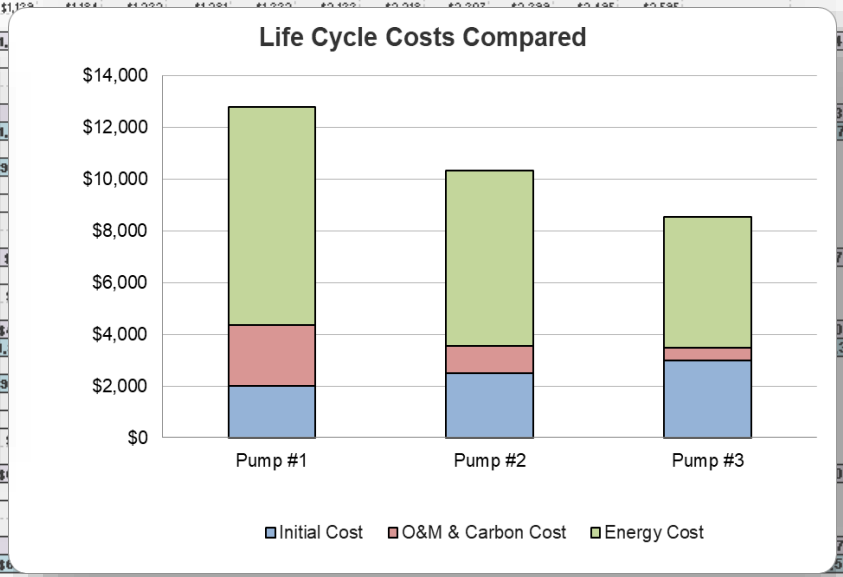
Simple Life Cycle Costing Tool | Other Inflation Rate 2.0% | Energy Inflation Rate 4.0% | Discount Rate 3.0%

Option A - Initial Costs	Cost		0	1	2	3	4	5	6	7	8	9	10	11	12	13	25	26	27	28	29	30	Present Value	After
Pump #1	$2,000		$2,000	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$2,000	10 Years
Energy Costs	Usage	Price	$/yr																					
Electricity (kWh)	5,000	$0.16	$800	$832	$865	$900	$936	$973	$1,012	$1,053	$1,095	$1,139	$1,184	$1,232	$1,281	$1,332	$2,132	$2,218	$2,307	$2,399	$2,495	$2,595		
Natural Gas (m3)	0	$0.00	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0		
Energy Sub-Total			$800	$832	$865	$900	$936	$973	$1,012	$1,053	$1,095	$1,139	$1,184	$1,232	$1,281	$1,332	$2,132	$2,218	$2,307	$2,399	$2,495	$2,595		40
O&M																								
Carbo																								
O&M & Ca																								359
Optio																								799
Option B																								
O&I																								752
Ca																								
O&M & C																								061
Optio																								313
Option C																								
Natural Gas (m3)	0	$0.00	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0		
Energy Sub-Total			$480	$499	$519	$540	$562	$584	$607	$632	$657	$6												064
O&M & Carbon Cost	Cost	Period	0																					
O&M Cost	$250	4	$250	$0	$0	$0	$271	$0	$0	$0	$293													
Carbon Tax (on Nat Gas)	0	Tonnes		$0	$0	$0	$0	$0	$0	$0	$0													
O&M & Carbon Sub-Total	$250		$250	$0	$0	$0	$271	$0	$0	$0	$293													72
Option C - Total Annual Costs			$3,000	$499	$519	$540	$832	$584	$607	$632	$350	$6												536

Carbon Tax ($ per Tonne, calculated by formula)		$66	$80	$95	$110	$125	$139	$154	$169	$184	$198	$213	$228	$242	$419	$434	$449	$463	$478	$493		
User Selected Carbon Tax/Price																						
Carbon Price to be used in Calculation ($/Tonne)		**$66**	**$80**	**$95**	**$110**	**$125**	**$139**	**$154**	**$169**	**$184**	**$198**	**$213**	**$228**	**$242**	**$419**	**$434**	**$449**	**$463**	**$478**	**$493**		

Life Cycle Costing Summary

	Option A	Option B	Option C
	Pump #1	Pump #2	Pump #3
Initial Cost	$2,000	$2,500	$3,000
O&M & Carbon Cost	$2,359	$1,061	$472
Energy Cost	$8,440	$6,752	$5,064
Total Cost	**$12,799**	**$10,313**	**$8,536**



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4. Calculate key financial indicators

Net Present Value (NPV)

Internal Rate of Return (IRR)

*the annualized effective compounded **return rate** or **rate of return** that makes the net present value of all cash flows (both positive and negative) equal to zero.*

Savings to Investment Ratio (SIR)

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Key financial indicators (option C vs option A)

Financial Value Indicators (Option C vs Option A)

Net Investment	$1,000	
Net Present Value	$4,263	
Internal Rate of Return	52.9%	
Savings to Investment Ratio	5.26	
Time Horizon (1-30 years)	10	years

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5. Perform basic sensitivity analysis

Option A - Initial Costs	Cost		0	1	2	3	4	5	6	7	8	9	10
Pump #1	$2,000		$2,000	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Energy Costs	**Usage**	**Price**	**$/yr**										
Electricity (kWh)	5,000	$0.25	$1,250	$1,300	$1,352	$1,406	$1,462	$1,521	$1,582	$1,645	$1,711	$1,779	$1,850
Natural Gas (m3)	0	$0.00	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Energy Sub-Total			**$1,250**	**$1,300**	**$1,352**	**$1,406**	**$1,462**	**$1,521**	**$1,582**	**$1,645**	**$1,711**	**$1,779**	**$1,850**
O&M & Carbon Cost	**Cost**	**Period**	**0**										
O&M Cost	$1,000	2	$1,000	$0	$1,040	$0	$1,082	$0	$1,126	$0	$1,172	$0	$1,219
Carbon Tax (on Nat Gas)	0	Tonnes		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
O&M & Carbon Sub-Total	**$1,000**		**$1,000**	**$0**	**$1,040**	**$0**	**$1,082**	**$0**	**$1,126**	**$0**	**$1,172**	**$0**	**$1,219**
Option A - Total Annual Costs			**$2,000**	**$1,300**	**$2,392**	**$1,406**	**$2,545**	**$1,521**	**$2,708**	**$1,645**	**$2,882**	**$1,779**	**$3,069**

Option B - Initial Costs	Cost		0	1	2	3	4	5	6	7	8	9	10
Pump #2	$2,500		$2,500	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Energy Costs	**Usage**	**Price**	**$/yr**										
Electricity (kWh)	4,000	$0.25	$1,000	$1,040	$1,082	$1,125	$1,170	$1,217	$1,265	$1,316	$1,369	$1,423	$1,480
Natural Gas (m3)	0	$0.40	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Energy Sub-Total			**$1,000**	**$1,040**	**$1,082**	**$1,125**	**$1,170**	**$1,217**	**$1,265**	**$1,316**	**$1,369**	**$1,423**	**$1,480**
O&M & Carbon Cost	**Cost**	**Period**	**0**										
O&M Cost	$750	3	$750	$0	$0	$796	$0	$0	$845	$0	$0	$896	$0
Carbon Tax (on Nat Gas)	0	Tonnes		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
O&M & Carbon Sub-Total	**$750**		**$750**	**$0**	**$0**	**$796**	**$0**	**$0**	**$845**	**$0**	**$0**	**$896**	**$0**
Option B - Total Annual Costs			**$2,500**	**$1,040**	**$1,082**	**$1,921**	**$1,170**	**$1,217**	**$2,110**	**$1,316**	**$1,369**	**$2,320**	**$1,480**

Option C - Initial Costs	Cost		0	1	2	3	4	5	6	7	8	9	10
Pump #3	$3,000		$3,000	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Energy Costs	**Usage**	**Price**	**$/yr**										
Electricity (kWh)	3,000	$0.25	$750	$780	$811	$844	$877	$912	$949	$987	$1,026	$1,067	$1,110
Natural Gas (m3)	0	$0.00	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Energy Sub-Total			**$750**	**$780**	**$811**	**$844**	**$877**	**$912**	**$949**	**$987**	**$1,026**	**$1,067**	**$1,110**
O&M & Carbon Cost	**Cost**	**Period**	**0**										
O&M Cost	$500	4	$500	$0	$0	$0	$541	$0	$0	$0	$586	$0	$0
Carbon Tax (on Nat Gas)	0	Tonnes		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
O&M & Carbon Sub-Total	**$500**		**$500**	**$0**	**$0**	**$0**	**$541**	**$0**	**$0**	**$0**	**$586**	**$0**	**$0**
Option C - Total Annual Costs			**$3,000**	**$780**	**$811**	**$844**	**$1,419**	**$912**	**$949**	**$987**	**$1,612**	**$1,067**	**$1,110**

Carbon Tax ($ per Tonne, calculated by formula)		$66	$80	$95	$110	$125	$139	$154	$169	$184	$198
User Selected Carbon Tax/Price											
Carbon Price to be used in Calculation ($/Tonne)		**$66**	**$80**	**$95**	**$110**	**$125**	**$139**	**$154**	**$169**	**$184**	**$198**

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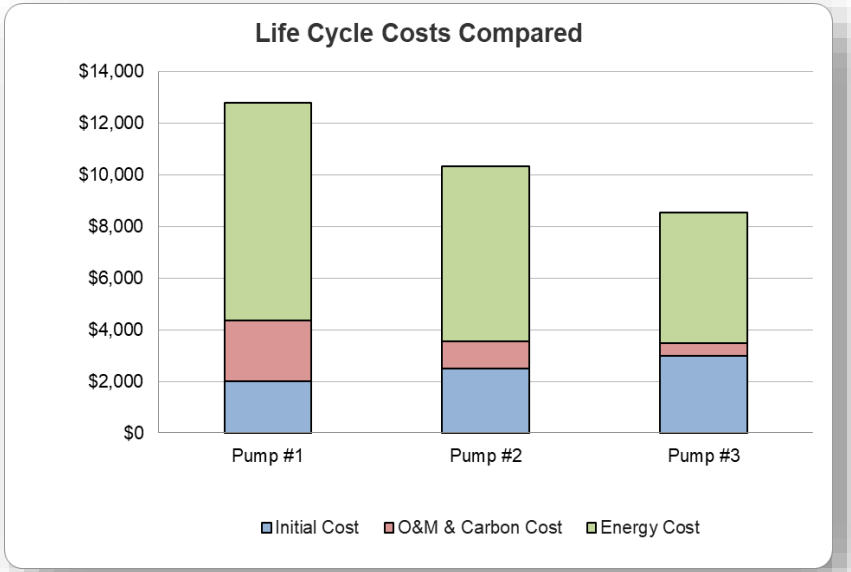
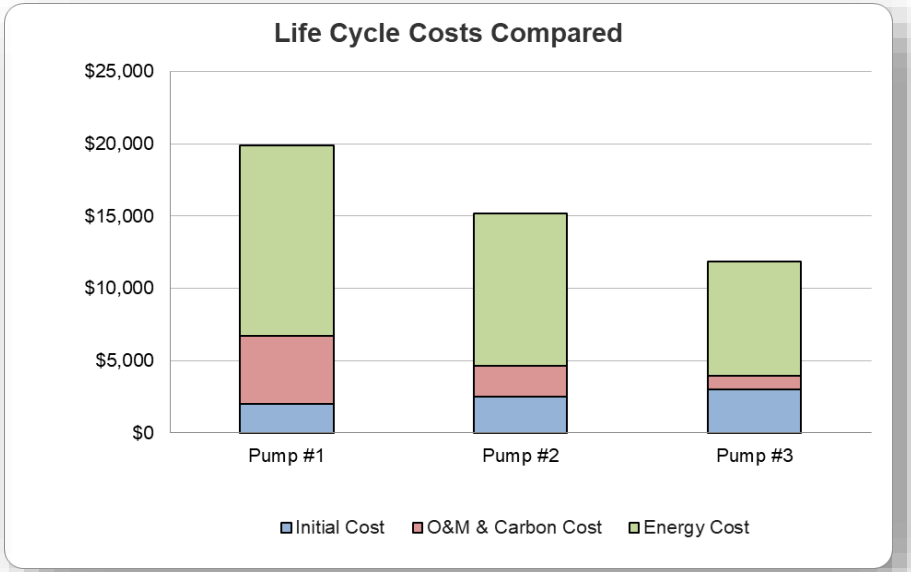
Perform basic sensitivity analysis - look at maintenance cost increases





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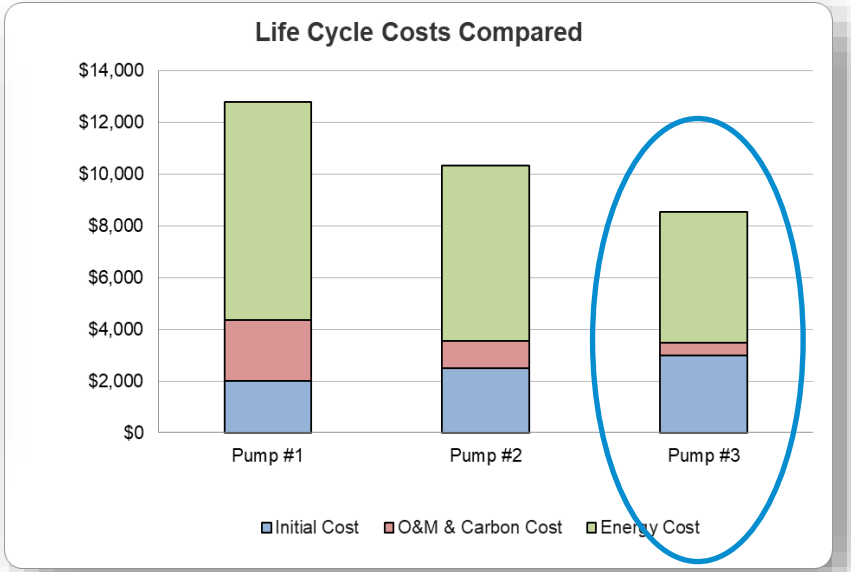
6. Take the best decision

Life Cycle Costing Summary

	Option A	Option B	Option C
	Pump #1	**Pump #2**	**Pump #3**
Initial Cost	$2,000	$2,500	$3,000
O&M & Carbon Cost	$2,359	$1,061	$472
Energy Cost	$8,440	$6,752	$5,064
Total Cost	**$12,799**	**$10,313**	**$8,536**



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Let's look at how the spreadsheet works…

Simple Life Cycle Costing Tool			Other Inflation Rate	2.0%	Energy Inflation Rate	4.0%	Discount Rate	3.0%																		
Option A - Initial Costs	**Cost**		**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**25**	**26**	**27**	**28**	**29**	**30**	**Present Value**	**After**
Pump #1	$2,000		$2,000	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	**$2,000**	**10 Years**
Energy Costs	**Usage**	**Price**	**$/yr**																					
Electricity (kWh)	5,000	$0.16	$800	$832	$865	$900	$936	$973	$1,012	$1,053	$1,095	$1,139	$1,184	$1,232	$1,281	$1,332	$2,133	$2,218	$2,307	$2,399	$2,495	$2,595		
Natural Gas (m3)	0	$0.00	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0		
Energy Sub-Total			**$800**	**$832**	**$865**	**$900**	**$936**	**$973**	**$1,012**	**$1,053**	**$1,095**	**$1,139**	**$1,184**	**$1,232**	**$1,281**	**$1,332**	**$2,133**	**$2,218**	**$2,307**	**$2,399**	**$2,495**	**$2,595**	**$27,975**	**$8,440**
O&M & Carbon Cost	**Cost**	**Period**	**0**																					
O&M Cost	$500	2	$500	$0	$520	$0	$541	$0	$563	$0	$586	$0	$609	$0	$634	$0	$0	$837	$0	$871	$0	$906		
Carbon Tax (on Nat Gas)	0	Tonnes		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0		
O&M & Carbon Sub-Total	**$500**		**$500**	**$0**	**$520**	**$0**	**$541**	**$0**	**$563**	**$0**	**$586**	**$0**	**$609**	**$0**	**$634**	**$0**	**$0**	**$837**	**$0**	**$871**	**$0**	**$906**	**$6,439**	**$2,359**
Option A - Total Annual Costs			**$2,000**	**$832**	**$1,385**	**$900**	**$1,477**	**$973**	**$1,575**	**$1,053**	**$1,681**	**$1,139**	**$1,794**	**$1,232**	**$1,915**	**$1,332**	**$2,133**	**$3,055**	**$2,307**	**$3,269**	**$2,495**	**$3,500**	**$36,414**	**$12,799**

Option B - Initial Costs	**Cost**		**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**25**	**26**	**27**	**28**	**29**	**30**	**Present Value**
Pump #2	$2,500		$2,500	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	**$2,500**
Energy Costs	**Usage**	**Price**	**$/yr**																				
Electricity (kWh)	4,000	$0.16	$640	$666	$692	$720	$749	$779	$810	$842	$876	$911	$947	$985	$1,025	$1,066	$1,706	$1,774	$1,845	$1,919	$1,996	$2,076	
Natural Gas (m3)	0	$0.40	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	
Energy Sub-Total			**$640**	**$666**	**$692**	**$720**	**$749**	**$779**	**$810**	**$842**	**$876**	**$911**	**$947**	**$985**	**$1,025**	**$1,066**	**$1,706**	**$1,774**	**$1,845**	**$1,919**	**$1,996**	**$2,076**	**$22,380**	**$6,752**
O&M & Carbon Cost	**Cost**	**Period**	**0**																				
O&M Cost	$375	3	$375	$0	$0	$398	$0	$0	$422	$0	$0	$448	$0	$0	$476	$0	$0	$0	$640	$0	$0	$679	
Carbon Tax (on Nat Gas)	0	Tonnes		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0		
O&M & Carbon Sub-Total	**$375**		**$375**	**$0**	**$0**	**$398**	**$0**	**$0**	**$422**	**$0**	**$0**	**$448**	**$0**	**$0**	**$476**	**$0**	**$0**	**$0**	**$640**	**$0**	**$0**	**$679**	**$3,204**	**$1,061**
Option B - Total Annual Costs			**$2,500**	**$666**	**$692**	**$1,118**	**$749**	**$779**	**$1,232**	**$842**	**$876**	**$1,359**	**$947**	**$985**	**$1,500**	**$1,066**	**$1,706**	**$1,774**	**$2,485**	**$1,919**	**$1,996**	**$2,755**	**$28,084**	**$10,313**

Option C - Initial Costs	**Cost**		**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**25**	**26**	**27**	**28**	**29**	**30**	**Present Value**
Pump #3	$3,000		$3,000	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	**$3,000**
Energy Costs	**Usage**	**Price**	**$/yr**																				
Electricity (kWh)	3,000	$0.16	$480	$499	$519	$540	$562	$584	$607	$632	$657	$683	$711	$739	$768	$799	$1,280	$1,331	$1,384	$1,439	$1,497	$1,557	
Natural Gas (m3)	0	$0.00	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	
Energy Sub-Total			**$480**	**$499**	**$519**	**$540**	**$562**	**$584**	**$607**	**$632**	**$657**	**$683**	**$711**	**$739**	**$768**	**$799**	**$1,280**	**$1,331**	**$1,384**	**$1,439**	**$1,497**	**$1,557**	**$16,785**	**$5,064**
O&M & Carbon Cost	**Cost**	**Period**	**0**																				
O&M Cost	$250	4	$250	$0	$0	$0	$271	$0	$0	$0	$293	$0	$0	$0	$317	$0	$0	$0	$0	$435	$0	$0	
Carbon Tax (on Nat Gas)	0	Tonnes		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0		
O&M & Carbon Sub-Total	**$250**		**$250**	**$0**	**$0**	**$0**	**$271**	**$0**	**$0**	**$0**	**$293**	**$0**	**$0**	**$0**	**$317**	**$0**	**$0**	**$0**	**$0**	**$435**	**$0**	**$0**	**$1,502**	**$472**
Option C - Total Annual Costs			**$3,000**	**$499**	**$519**	**$540**	**$832**	**$584**	**$607**	**$632**	**$950**	**$683**	**$711**	**$739**	**$1,086**	**$799**	**$1,280**	**$1,331**	**$1,384**	**$1,875**	**$1,497**	**$1,557**	**$21,287**	**$8,536**

Carbon Tax ($ per Tonne, calculated by formula)		$66	$80	$95	$110	$125	$139	$154	$169	$184	$198	$213	$228	$242	$419	$434	$449	$463	$478	$493	
User Selected Carbon Tax/Price																					
Carbon Price to be used in Calculation ($/Tonne)		**$66**	**$80**	**$95**	**$110**	**$125**	**$139**	**$154**	**$169**	**$184**	**$198**	**$213**	**$228**	**$242**	**$419**	**$434**	**$449**	**$463**	**$478**	**$493**	

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Life cycle costing : case study

Coldstream fire station – Middlesex Centre

- Middlesex Centre, ON
- 10,000 sq/ft fire hall
- 6-bay apparatus bay
- Completed in 2017
- Achieved net zero energy in [2017/2018] and thereafter.
- "First net zero energy fire hall in Canada"

ieso Connecting Today. Powering Tomorrow.

SAVE ON ENERGY POWER WHAT'S NEXT

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Coldstream Fire Department
10241
Iderton Rd
10227
Municipality of Middlesex Ctr

LCC & net zero emissions/carbon neutral

Type of construction	Initial cost	Energy consumption (ekWh/year)	Annual energy cost (electricity & natural gas)	CO2 emissions (kg/year)
Option A: Normal Fire Hall (ASHRAE 90.1 – 2010)	$2,200,000	162,530	$10,310	26,741
Option B: Energy efficient (high performance envelope)	$2,500,000	148,366	$9,850	24,227
Option C: Net zero emission/carbon neutral GSHP & photovoltaic	$2,800,000	120,112	$0	0

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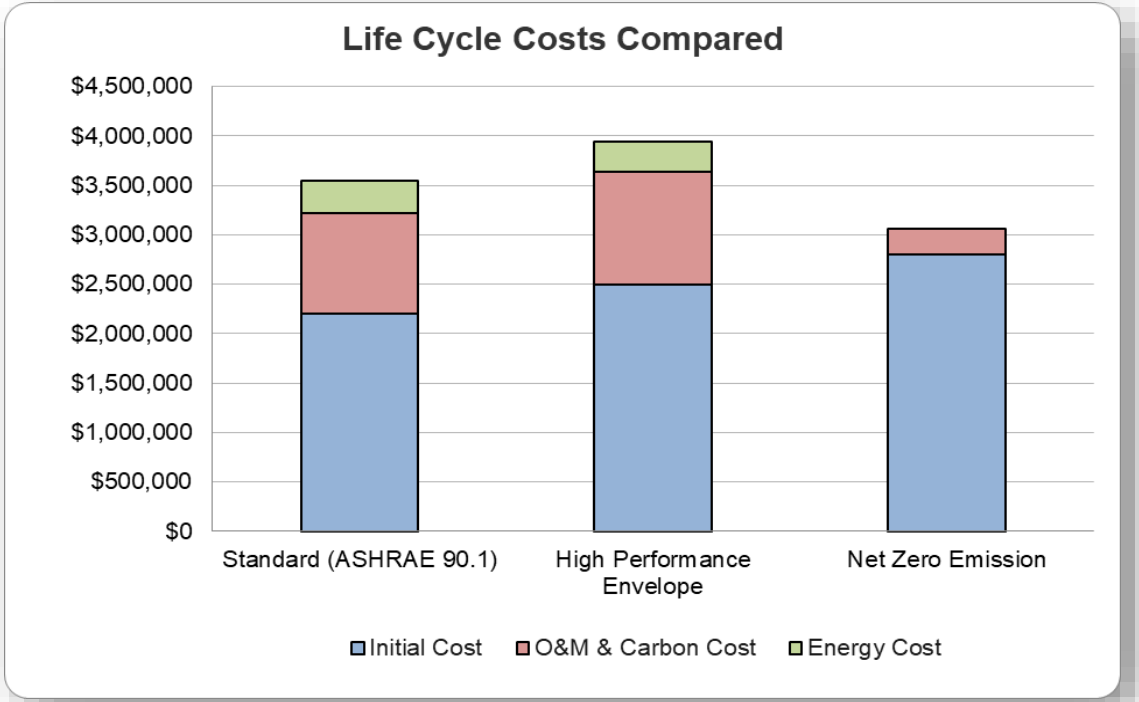
Fire Hall - LCC of 3 options



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Make the best decision

Life Cycle Costing Summary

	Option A **Standard (ASHRAE 90.1)**	Option B **High Performance Envelope**	Option C **Net Zero Emission**
Initial Cost	$2,200,000	$2,500,000	$2,800,000
O&M & Carbon Cost	$1,022,690	$1,140,083	$258,818
Energy Cost	$325,208	$305,990	$0
Total Cost	**$3,547,898**	**$3,946,072**	**$3,058,818**

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The help desk is now open…

Christian Tham
AMO/LAS
ctham@amo.on.ca

Stephen Dixon
Knowenergy
sdixon@knowenergy.com

Thanks for your participation!

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Post-webinar support

One-on-one coaching: tailored support for managing energy resources effectively

Post-webinar support intake form

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Thank you!

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