RENEWABLE ENERGY FOR AN AVERAGE HOUSEHOULD IN EDMONTON

MECH 431 :: ENGINEERING ECONOMIC ANALYSIS

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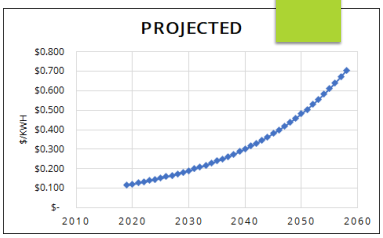
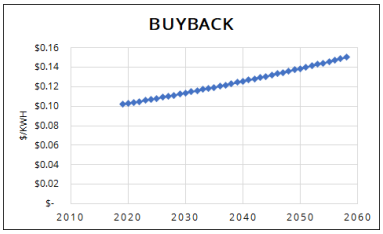
Introduction

- There will be a non-renewable energy crisis and the projected price for electricity is increasing, fast!
- Renewable energy is appealing
- Solar is extra appealing in Edmonton
- Edmonton is one of the most sunniest cities in Canada!





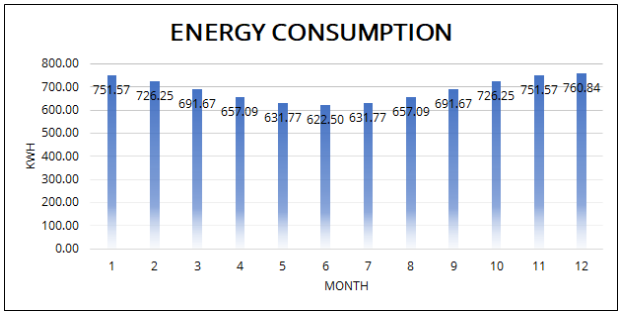
Increasing in electrical costs have made renewable energy more appealing

This analysis explore the viability of these renewable option

Edmonton being the sunniest place is the perfect testing ground

Energy Consumption

- The average Albertan household consumes 7900 kWh each day
- Using 8300 kWh as benchmark
- Higher usage during winter (darker and colder)



First start with average energy consumption

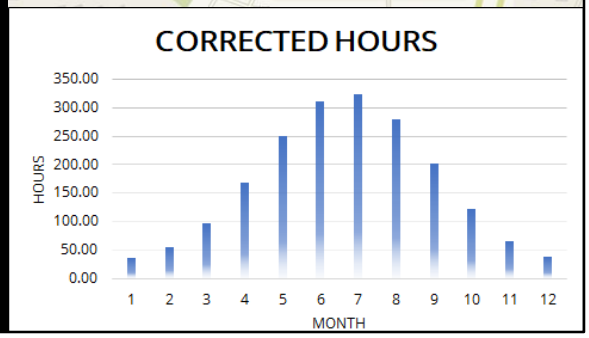
The average Albertan household consumes 7900 kWh each day

Using 8300 kWh as benchmark for safety

Higher usage during winter (darker and colder) because heating and lighting is used more

Weather

- The most uncertain aspect of the analysis
- Luckily not as sensitive to outcome
- Modelled and simulated using real data

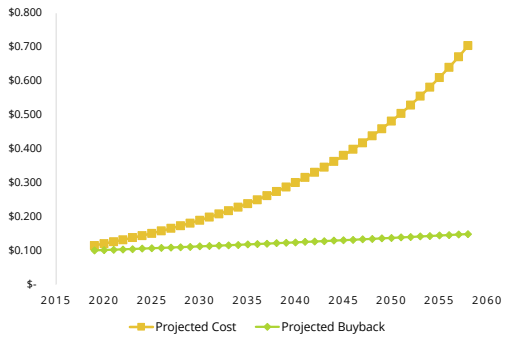


The most uncertain aspect of the analysis at 17% according to one study

Luckily not as sensitive to outcome because it does not affect the nominal IRR by a significant amount

The weather is modelled and simulated using real data such as minimum day light and sun light times. Python scripts are written to simulate the sinusoidal characteristics of sun from days, to months, to years.

Grid Electricity



- Projected cost expected to rise dramatically
- Solar systems can act as microgenerators to contribute to the grid
- Buyback rate for excess generated energy is appealing

Analysis of grid electricity rates of the future

The projected cost will increase at 5.1% annually

The buyback rate is projected to be at only 1%. However in the near future, this is still appealing

Source of Capital

- Assume $10,000 in cash in savings
- Anything cost more than that to install will be taken from loans
- Loans have 5 or 15 year terms
- Loan has prime rate (3%) + 2% interest rate
- Some installation services take bitcoins

Government Incentives:

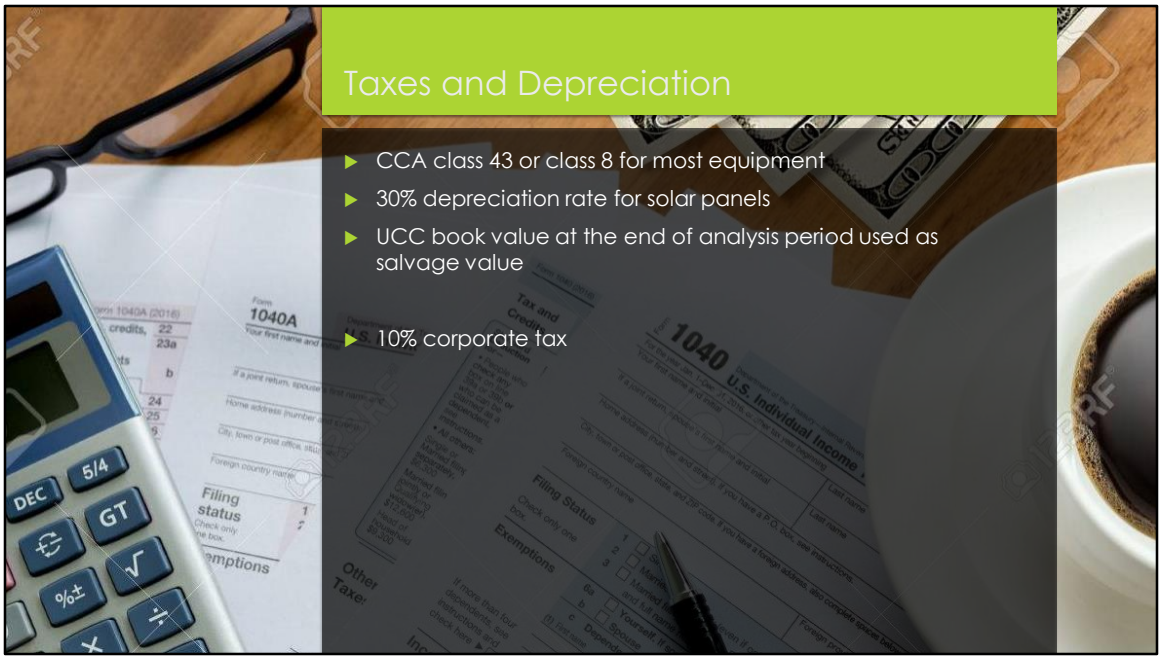
- Rebate for residential up to $10,000 or 30% of investment
- Rebate for Businesses up to $500,000 or 25% of investment
- Additional $0.15/W rebate from the city

If project is below $10000, the project can be purchased using cash

Otherwise loan is taken

Loan has interest 2% above prime interest rate of 3%

There are also government incentives



CCA class 43 or class 8 for most electrical equipment

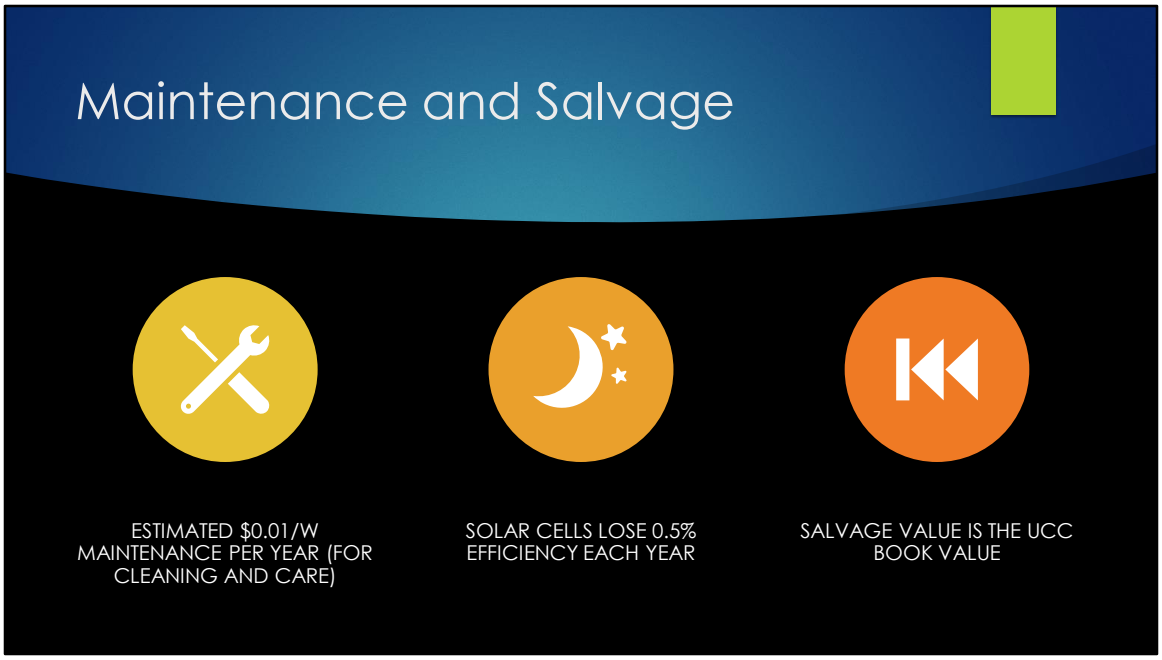
Exception is the mechanical stuff which is class 17

30% depreciation rate for solar panel equipment

Replacements will add to the UCC account

UCC book value at the end of analysis period used as salvage value

10% corporate tax

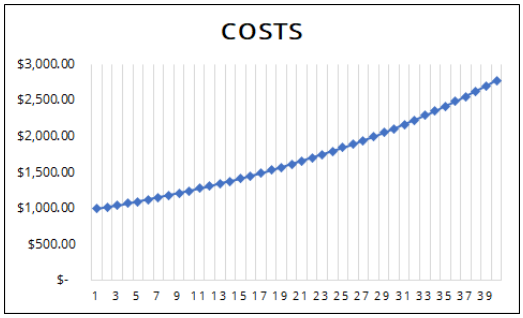


$100 per year for 10kW system

After 40 years the solar efficiency is still at 82%

Alternative 0: Do nothing

- Doing nothing means not installing any solar
- Paying the electric price as they rise even if the energy used is the same
- A reference where we can gauge other alternatives

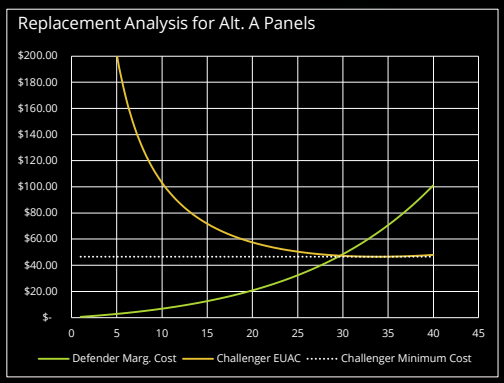


Alternative 1: Small scale 400W

- A 400W is very easy to setup
- Don't require professionals
- Cheap
- Long lasting

Alternative 1 Outcome

- 400W is too small
- Breakeven period is 26 years!
- IRR 3.67% or NPV $235.4 in 40 years (already accounted for 2% inflation rate)
- Replacement analysis shows solar panels needs replacement every 28 years



The replacement of the solar panel is actually not needed

Due to high installation cost being so late into the analysis (analysis period is finite)

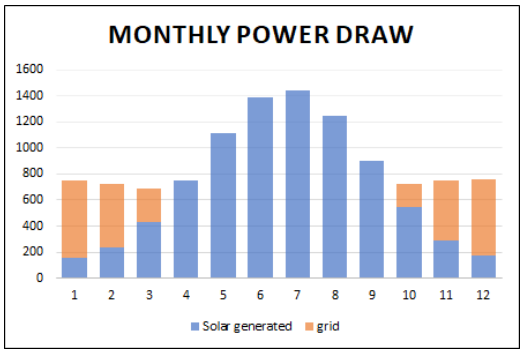
We won't consider replacing solar panels for all alternatives

Much larger, therefore extra cost needs to be inquired to hire professionals, engineering, and permitting

Provides much more energy (12.5x of alternative 1)
Can generate extra energy during the summer and be sold for extra income
Downside: very expensive to install; requires professionals
Downside: cannot sustain power demand completely in winter

Alternative 2 Outcome

- 15 year loan repayment is better than 5 year loan repayment because it avoids taxes
- Breakeven point is 24 years (only worth doing if lifetime is longer than this)
- Maximum of nominal IRR 7.89% or NPV of $7310 (already accounted for inflation rate)
- Has excess energy generated in the summer to sell



The blue region is the power from solar panels

The orange region is the power from the grid

We want to minimize the orange region and maximize the extended part (excess power)

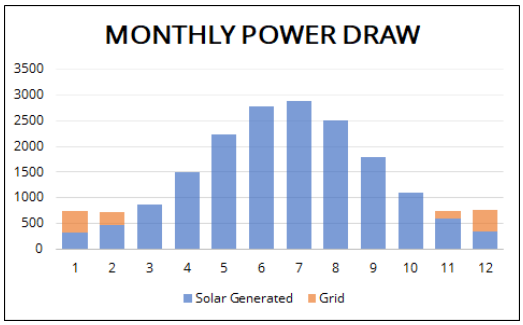
Alternative 3: Massive scale 10kW

- Largest capacity and production
- Lowest dollars per watt ratio
- Highest rate of return in 40 years
- Nearly unlimited supply of energy in the summer

Even larger, therefore even more extra cost needs to be inquired to hire professionals, engineering, and permitting

Alternative 3 Outcome

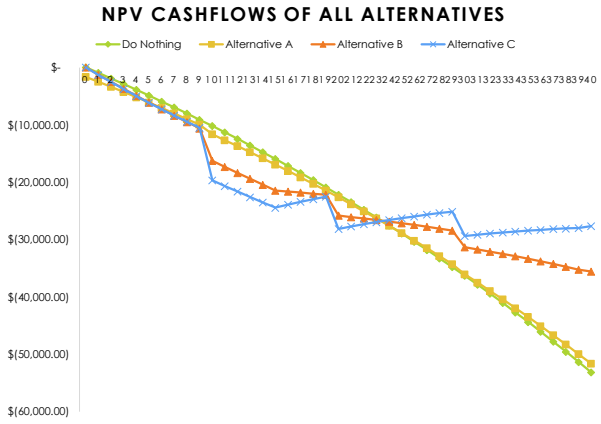
- 15 year loan repayment is better than 5 year loan repayment also
- Breakeven point is 24 years
- Maximum of nominal IRR 7.95% or NPV of $10573 (already accounted for inflation rate)
- Even more excess energy in summer
- Less reliance on grid in winter



We minimized the orange region and increased the blue base line significantly

Verdict

- If considering long term (28 years+) alternative 3 is the best
- Generally it's better to go with larger capacity systems
- Do nothing if period is shorter than 25 years



Choose solar

Choose alternative 3

Live at least 25 years