FINANCIAL INSTRUMENTS

ACCELERATING ZERO-EMISSION BUILDING SECTOR AMBITION IN THE MENA REGION

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BEIRUT, LEBANON
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Supported by:

Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety

based on a decision of the German Bundestag

THREE QUESTIONS TO BE ADDRESSED IN MY PRESENTATION

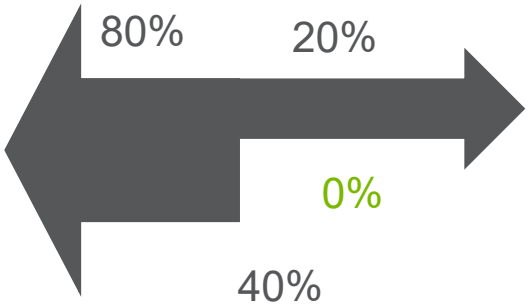
1. What needs did we identify in the scope of financing energy efficiency measures ?
2. What tool have we developed to address those needs ?
3. How is our tool being used in practice ?

NEED NUMBER ONE
MAJORITY NOT CONDUCTING ECONOMIC VALUATIONS

Do you conduct a cost benefit analysis for choosing heating and cooling designs?

17 project developers interviewed

~~Economic Assessment~~

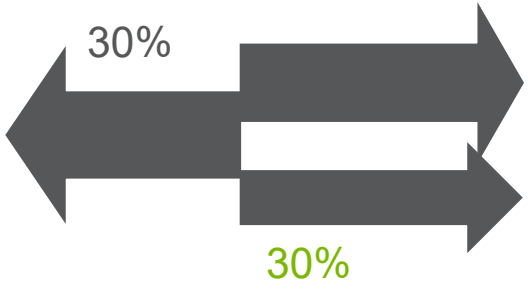


Static payback period

Net Present Valuation

21 project developers interviewed

~~Economic Assessment~~

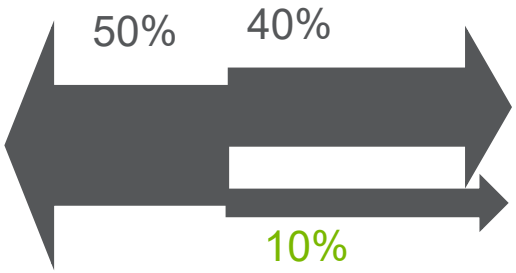


Static payback period

Net Present Valuation
(NEEREA obligation)

22 project developers interviewed

~~Economic Assessment~~



Static payback period

Net Present Valuation

NEED NUMBER TWO
ALTER THE MINDSET OF PAYBACK CALCULATIONS

Advantage

- Simple and easy method use to compare options
- Simple language to talk with client

Disadvantage

- Does **NOT** indicate the profitability of the asset over its lifespan
- Does **NOT** allow benchmarking of options with re-investments
- Does **NOT** take into account the time value of money
- Does **NOT** allow project developer to communicate with financial institutions

Solution

- Need a tool that can illustrate the value of NPV vs Payback for our customers
- Need a tool that can help me benchmark different energy efficiency options

NEED NUMBER THREE
IMPROVE THE CALCULATION OF NET PRESENT VALUATION

1. The calculation approach is not uniform across applications
   - Some consider free risk loans over the whole life
   - Some consider discount rates but do not share the rate
   - Some consider the grace period as totally free (no interest rate)
   - Some do not consider inflation and energy price fluctuations
   - Some do not consider depreciation over the lifetime neither considers

2. Methodology of calculation is not accurate
   - The difference in capital cost with the baseline is not taken into account which influence the NPV of the measure
   - When assessing heat pumps, only heating options were compared to baseline, whereas it's the benefits of heating + cooling that should be considered

3. Inputs are not fixed and outputs are not standardized

4. Setting a technology baseline to compare each energy efficiency measure

NEED NUMBER FOUR
UNDERSTAND THE IMPACT OF INPUT VARIABLES

Questions raised by project developers during training sessions:

“How will an increase or decrease in energy prices affect the net present valuation of my heat pump?”

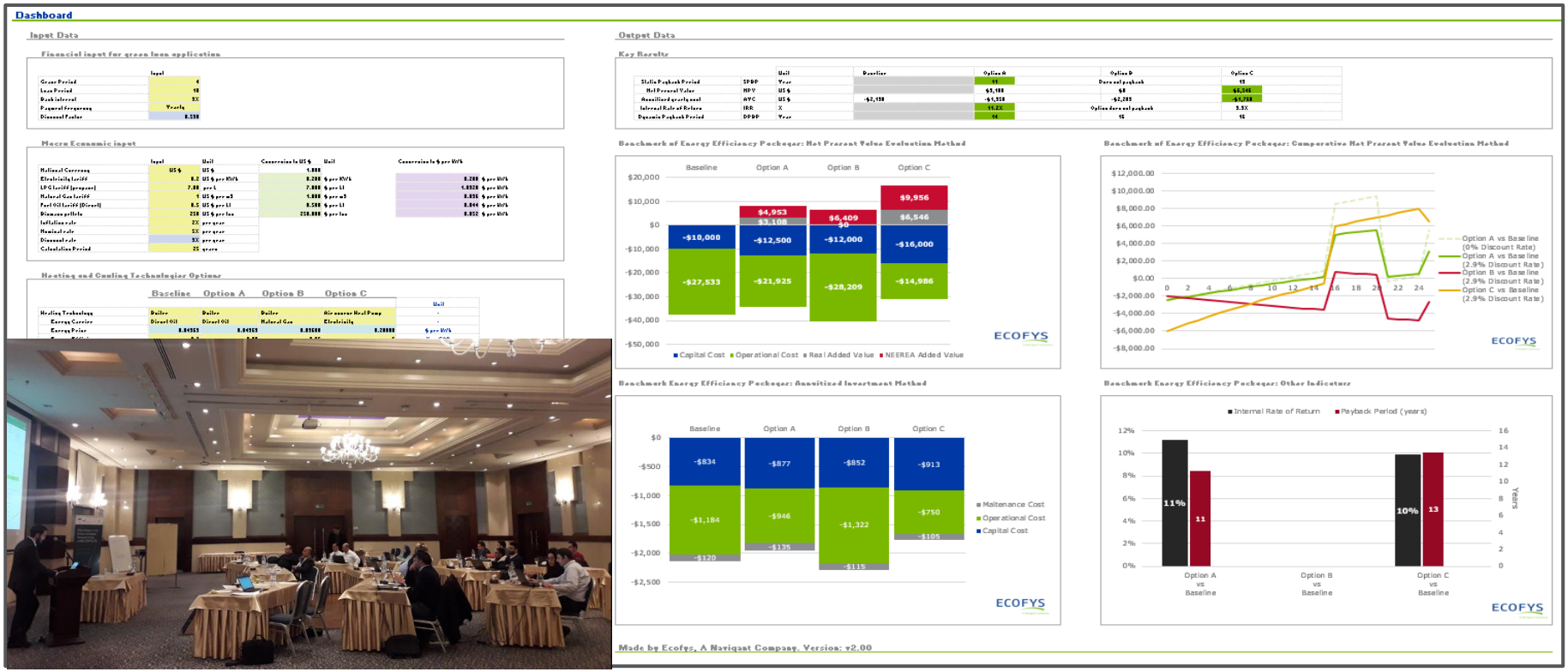
“How will the grace period or the interest loan affect the payments I need to do the bank?”

“How does the grace period or the interest loan affect the net present value of energy efficient options?”

“What is the maximum allowable risk I can take in this project so that it is still financially attractive?”

WHAT DID WE DO?
CAPACITY-BUILDING FOR ECONOMIC ASSESSMENTS

- Ecofys developed a dynamic standardized excel-based tool to evaluate the cost effectiveness of heating and cooling technologies
- The tool is designed to take financial and macro economic inputs tailored to each country
- Trainings were organized with project developers in parallel to the national workshops
- Feedback from participants was used to enhance and tweak the tool



STRUCTURED INPUTS
FINANCIAL, MACRO-ECONOMIC & ENGINEERING INPUT

Financial input for green loan

	Input
Grace Period	4
Loan Period	10
Bank interest	3%
Payment frequency	Yearly
Discount Factor	8.530

Finance data

Economy data

Equipment data

Engineering data

Macro Economic input

	Input	Unit	Conversion to US $	Unit	Conversion to $ per kWh	
National Currency	US $	US $	1.000			
Electricity tariff	0.2	US $ per KWh	0.200	$ per KWh	0.200	$ per kWh
LPG tariff (propane)	7.00	per L	7.000	$ per Lt	1.0328	$ per kWh
Natural Gas tariff	1	US $ per m3	1.000	$ per m3	0.096	$ per kWh
Fuel Oil tariff (Diesel)	0.5	US $ per Lt	0.500	$ per Lt	0.044	$ per kWh
Biomass pellets	250	US $ per ton	250.000	$ per ton	0.052	$ per kWh
Inflation rate	2%	per year				
Nominal rate	5%	per year				
Discount rate	3%	per year				
Calculation Period	25	years				

Heating and Cooling Technologies Options

	Baseline	Option A	Option B	Option C	Unit
Heating Technology	Boiler	Boiler	Boiler	Air source Heat Pump	-
Energy Carrier	Diesel Oil	Diesel Oil	Natural Gas	Electricity	-
Energy Price	0.04369	0.04369	0.09600	0.20000	$ per kWh
Energy Efficiency	0.7	0.80	0.95	5	% or COP
Capital Cost	8,000	10,000	9,000	16,000	$
Maitenance Cost	60	60	55	105	$ per year
Lifespan	15	20	20	25	Years
Cooling Technology	Air conditionnin	Air conditionning	Air conditionning	Air source Heat Pump	-
Energy Carrier	Electricity	Electricity	Electricity	Electricity	-
Energy Price	0.20000	0.20000	0.20000	0.20000	$ per kWh
Energy Efficiency	2.5	3.5	4.5	4	% or COP
Capital Cost	2,000	2,500	3,000	0	$
Maitenance Cost	60	75	60	0	$ per year
Lifespan	15	15	15	25	Years

Building Energy Consumption Data

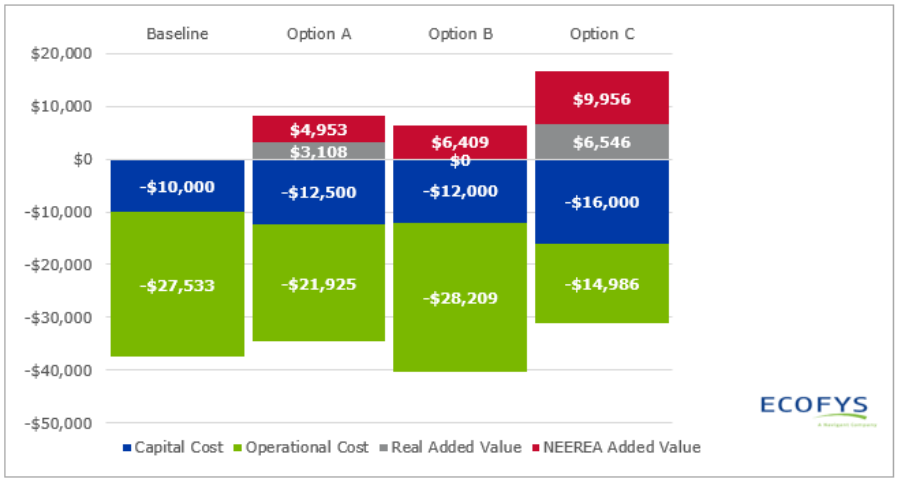
Surface Area	200	200	200	200	m2
Useful Heating Demand	50	50	50	50	kWh/m2.a
Useful Cooling Demand	35	35	35	35	kWh/m2.a
Final Heating Demand	14,286	12,500	10,526	2,000	kWh
Final Cooling Demand	2,800	2,000	1,556	1,750	kWh
Heating Cost	624	546	1,011	400	$ per year
Cooling Cost	560	400	311	350	$ per year
Total Energy Cost	1,184	946	1,322	750	$ per year
Total Maitenance Cost	120	135	115	105	$ per year
Total Capital Cost	10,000	12,500	12,000	16,000	$

VISUAL OUTPUTS
FINANCIAL INDICATORS AND BENCHMARKING OF OPTIONS

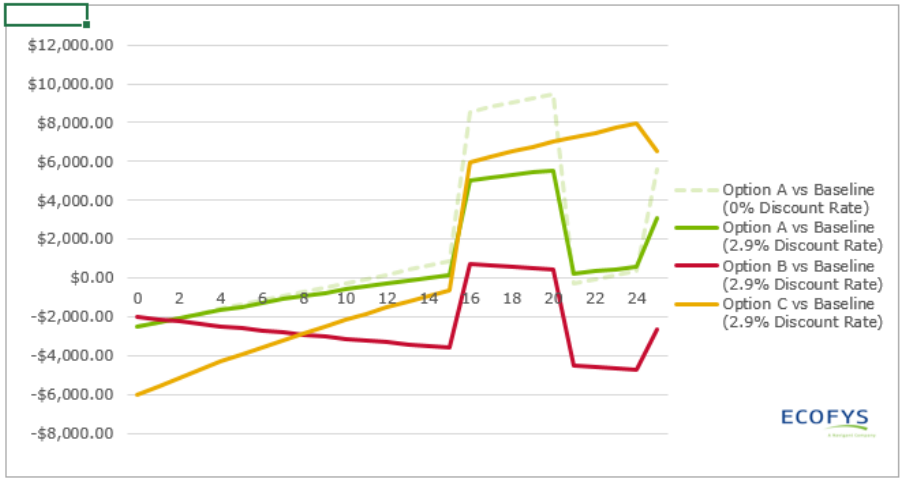
Key Results

		Unit	Baseline	Option A	Option B	Option C
Static Payback Period	SPBP	Year		11	Does not payback	13
Net Present Value	NPV	US $		$3,108	$0	$6,546
Annuitized yearly cost	AYC	US $	-$2,138	-$1,958	-$2,289	-$1,768
Internal Rate of Return	IRR	%		11.2%	Option does not payback	9.3%
Dynamic Payback Period	DPBP	Year		14	16	16

Benchmark of Energy Efficiency Packages: Net Present Value Evaluation Method



Benchmark of Energy Efficiency Packages: Comparative Net Present Value Evaluation Method



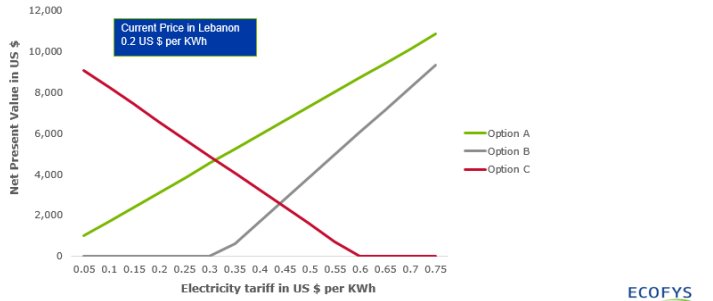
With respect to the financial and macro-economic inputs given today:

- Engineer would choose Option A following a static/dynamic payback period
- Over a calculation period of 25 years, its Option C with a lifespan of 25 years that has highest NPV
- The tool illustrate re-investment cycles and compare Options on a fair basis (i.e heatpumps vs cooling+heating of baseline)
- The tool illustrate the added value of the NEEREA loan, for shifting the down payment of the capital cost over the loan period

SENSITIVITY ANALYSIS
FUEL PRICES, DISCOUNT RATES AND CAPITAL COST

Electricity tariff

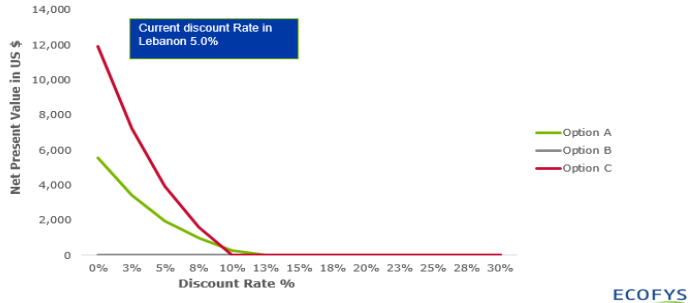
		Electricity tariff in US $ per KWh														
		0.05	0.1	0.15	0.2	0.25	0.3	0.35	0.4	0.45	0.5	0.55	0.6	0.65	0.7	0.75
A	3,108	1,004	1,705	2,407	3,108	3,809	4,510	5,211	5,912	6,613	7,314	8,015	8,717	9,418	10,119	10,820
		0.05	0.1	0.15	0.2	0.25	0.3	0.35	0.4	0.45	0.5	0.55	0.6	0.65	0.7	0.75
B	0	0	0	0	0	0	0	595	1,686	2,776	3,867	4,957	6,048	7,139	8,229	9,320
		0.05	0.1	0.15	0.2	0.25	0.3	0.35	0.4	0.45	0.5	0.55	0.6	0.65	0.7	0.75
C	6,546	9,044	8,211	7,379	6,546	5,714	4,881	4,049	3,216	2,383	1,551	718	0	0	0	0



ECOFYS

Discount Rate

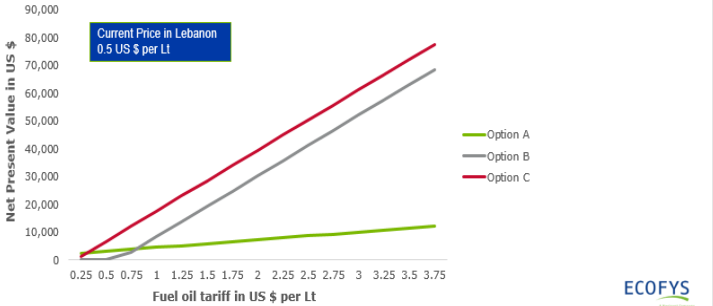
		Discount Rate %												
		0%	3%	5%	8%	10%	13%	15%	18%	20%	23%	25%	28%	30%
A	3,108	5,575	3,404	1,966	974	267	0	0	0	0	0	0	0	0
		0%	3%	5%	8%	10%	13%	15%	18%	20%	23%	25%	28%	30%
B	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0%	3%	5%	8%	10%	13%	15%	18%	20%	23%	25%	28%	30%
C	6,546	11,895	7,213	3,927	1,604	0	0	0	0	0	0	0	0	0



ECOFYS

Fuel Oil

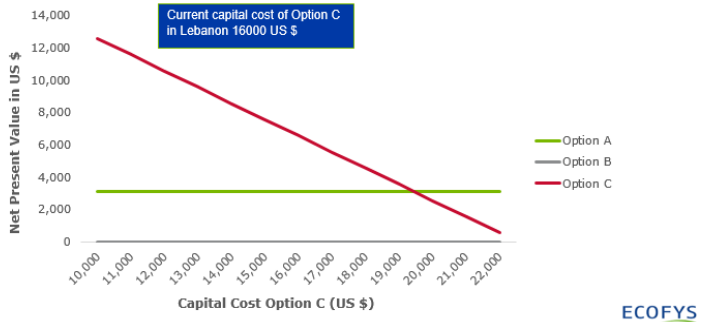
		Fuel oil tariff in US $ per Lt														
		0.25	0.5	0.75	1	1.25	1.5	1.75	2	2.25	2.5	2.75	3	3.25	3.5	3.75
A	3,108	2,424	3,108	3,791	4,475	5,159	5,843	6,526	7,210	7,894	8,578	9,261	9,945	10,629	11,312	11,996
		0.25	0.5	0.75	1	1.25	1.5	1.75	2	2.25	2.5	2.75	3	3.25	3.5	3.75
B	0	0	0	2,793	8,263	13,733	19,203	24,672	30,142	35,612	41,082	46,552	52,022	57,492	62,961	68,431
		0.25	0.5	0.75	1	1.25	1.5	1.75	2	2.25	2.5	2.75	3	3.25	3.5	3.75
C	6,546	1,076	6,546	12,016	17,486	22,956	28,426	33,896	39,365	44,835	50,305	55,775	61,245	66,715	72,185	77,654



ECOFYS

Capital Cost of Option C

		Capital Cost Option C (US $)												
		10,000	11,000	12,000	13,000	14,000	15,000	16,000	17,000	18,000	19,000	20,000	21,000	22,000
A	3,108	3,108	3,108	3,108	3,108	3,108	3,108	3,108	3,108	3,108	3,108	3,108	3,108	3,108
		10,000	11,000	12,000	13,000	14,000	15,000	16,000	17,000	18,000	19,000	20,000	21,000	22,000
B	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		10,000	11,000	12,000	13,000	14,000	15,000	16,000	17,000	18,000	19,000	20,000	21,000	22,000
C	6,546	12,546	11,546	10,546	9,546	8,546	7,546	6,546	5,546	4,546	3,546	2,546	1,546	546



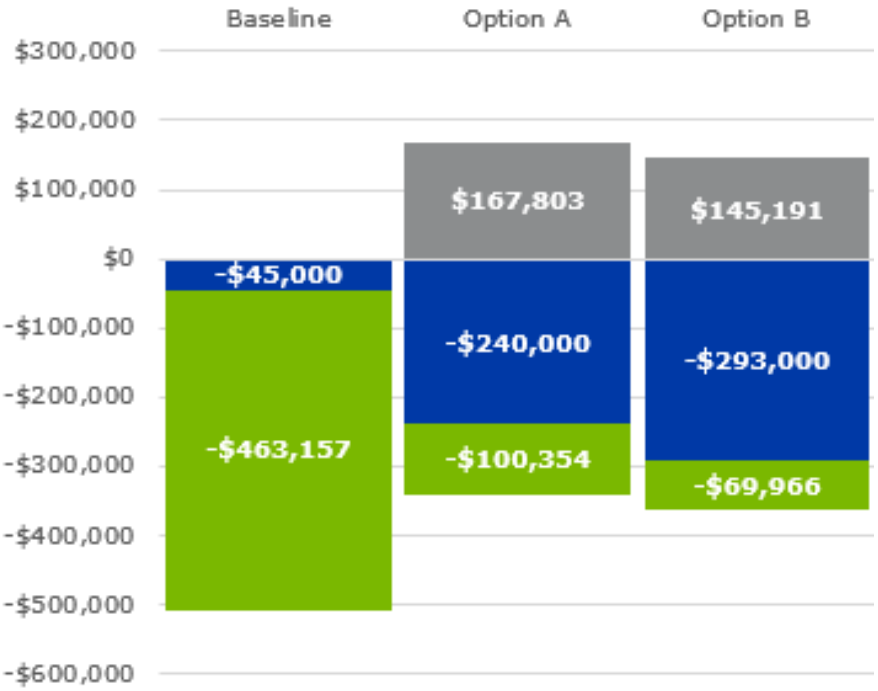
ECOFYS

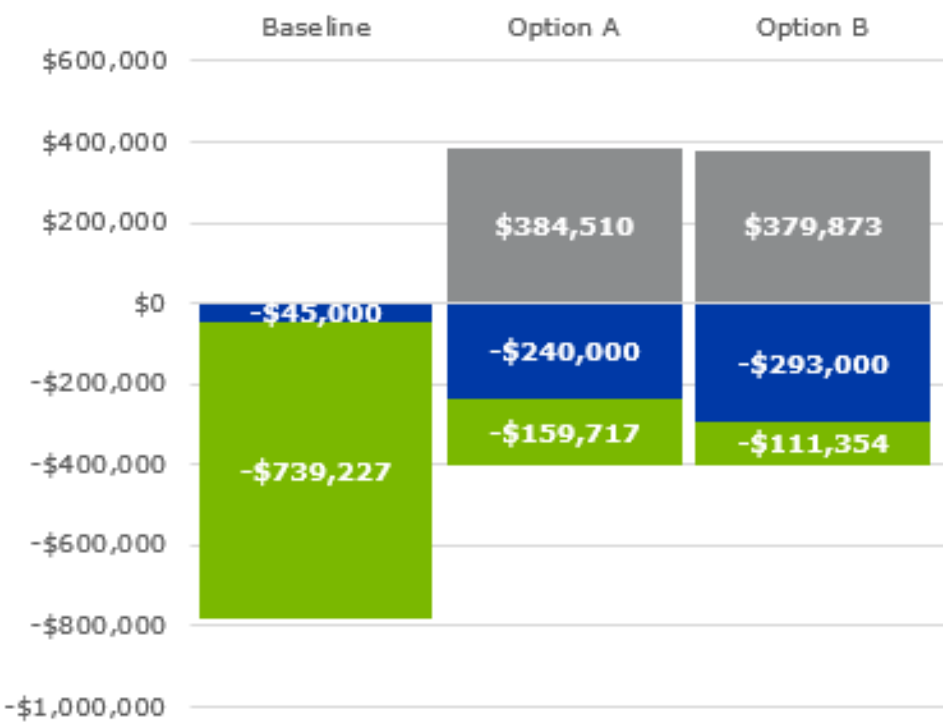
HOW HAS THE TOOL BEEN USED?
REAL CASE STUDIES IN LEBANON

- **The Project**
  - Heating/Cooling solution for Dar El Sadaka orphanage, Zahle (11 buildings).
- **Options:**
  - Diesel Boilers, Air Conditioners & PV System (Baseline)
  - Air Conditioners & PV System (Option A)
  - High-Efficiency Heat Pump & PV System (Option B), low-interest rate applies
- **Tool Used For:**
  - Feasibility study for 3 options
  - Evaluation considered initial investment, operation and maintenance costs, time-value of money, and interest rate
- **Results:**
  - Option B is most feasible considering 20-year calculation period.

HOW HAS THE TOOL BEEN USED?
REAL CASE STUDIES IN LEBANON

- Chart to left shows results with normal interest rate, while chart to left includes low-interest rate.
- Low rate only applies to Option B, which is why it turned out to be most fesible.





HOW WILL THE TOOL BEEN USED?
LIKELY ROLL OUT OF THE TOOL FOR NEEREA (IN PROCESS)

THANK YOU FOR YOUR ATTENTION

QUESTIONS?

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