

As requested:

In summary, the roof energy analysis for retrofitting a Tremlock T-138 system over an existing asphalt shingle roof vs replacing asphalt shingles, shows following the (6) main attributes:

That the proposed T-138 retrofit:

1. **is financially a better purchase/value** both in net present value and simple payback, due mainly to the multiple cost avoidance(s) of replacing asphalt shingles in the future.
2. **will yield greater energy savings**, both annual and overall long-term.
3. **is better for the environment/sustainable**, due long-term landfill diversion from asphalt shingles replacement and annual CO2 offset from annual energy savings in the short term.
4. has **larger project savings** (i.e. energy & cost avoidance) over a 40-year period.
5. has **lower project cost/payments** (i.e. one install vs multiple shingle replacements) over a 40-year period.
6. has **better estimated future cash flow** (i.e. negative cash flow will indicate when owner/client will have to provide valuable capital to support project) vs asphalt shingles over a 40-year period.

Additionally, this analysis can show:

- a. Location of optimal R-value
- b. Location of diminishing return at increasing insulation
- c. Estimated before and after roof surface temperatures
- d. Estimated before and after R-values
- e. Estimated R-value equivalency of proposed roof surface due to solar reflectivity, thermal emittance and the T-138 "A.S.V." (air gap)

Hope this helps, if not please let me know.

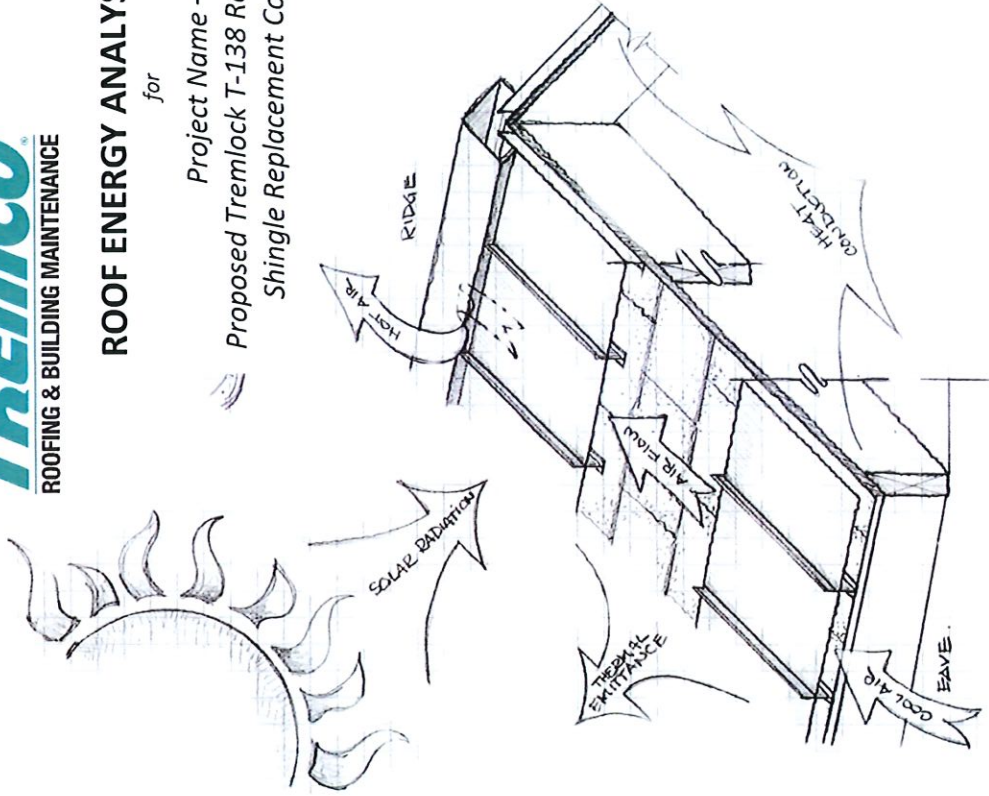
Thanks,
Rich

Richard Crawford, AIA, CEM
Energy Engineer
Tremco Roofing and Building Maintenance
Rcrawford@tremcoinc.com
513.490.4594

ROOF ENERGY ANALYSIS REPORT

for

Project Name –
 Proposed Tremlock T-138 Roof Retrofit vs
 Shingle Replacement Comparison

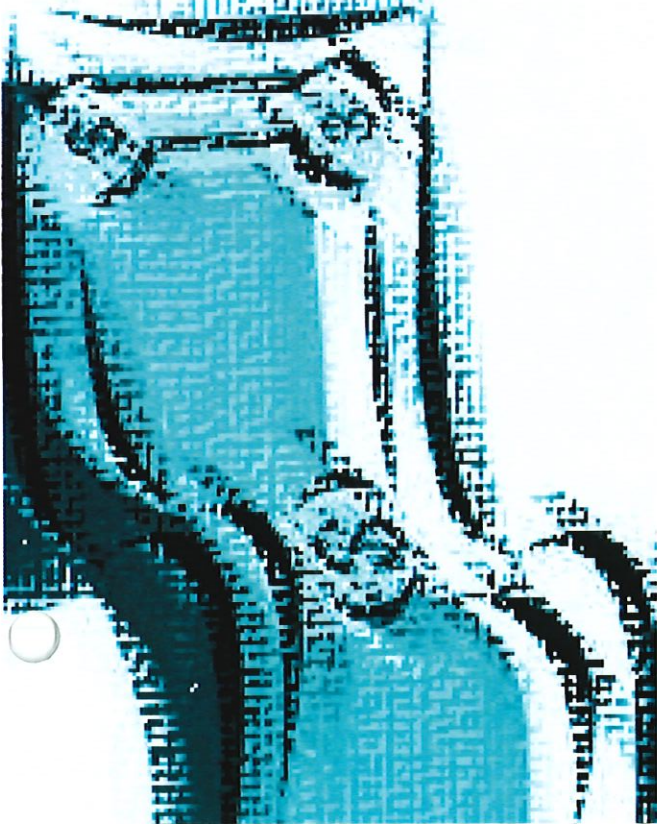


PURPOSE OF THIS ROOF ENERGY ANALYSIS:

Tremco Roofing and Building Maintenance would like to present to you this roof energy analysis report. Purpose of this report is to examine and compare proposed roofing systems (i.e. Tremlock T-138 Retrofit, Shingle replacements and retrofits etc.) through a financial analysis, estimate the annual energy savings, potential benefits of cool roofs and sustainable impacts.

TABLE OF CONTENTS:

Financial Analysis..... 1
 Energy Savings..... 2
 Potential Benefits..... 3
 Sustainability Impacts..... 4
 Energy and Financial Calculations..... Appendix

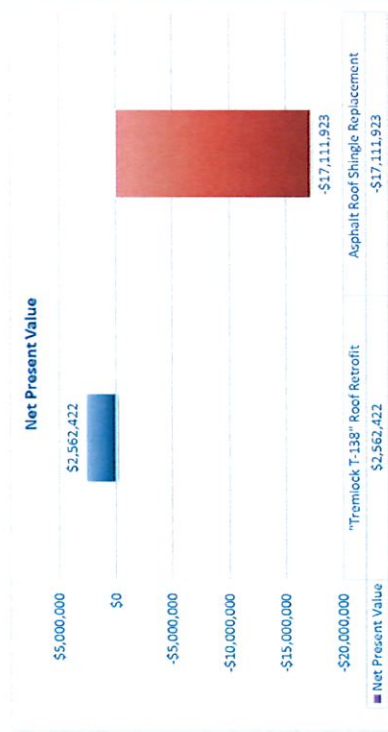


FINANCIAL ANALYSIS

Why a Financial Analysis?

Financial analysis (life cycle) allows one to compare proposed roofing solutions/options and determine which is best. For this analysis, the proposed (2) options are compared not only by simple payback, but more clearly, by the project's Net Present Value (NPV). The NPV is the net worth in today's dollars the proposed project's future net cash flows. Therefore, the best option is that solution, which has an NPV with the largest positive number, representing positive cash flow. A negative NPV means that the owner of the proposed roof will need to inject additional capital into the project.

For this project, the proposed "Ann A. Mullen Middle School - "Tremlock T-138" Roof Retrofit "is financially the better option, see chart below.



ROOF FINANCIAL ANALYSIS - EXECUTIVE SUMMARY

Ann A. Mullen Middle School	"Tremlock T-138" Roof Retrofit	Asphalt Roof Shingle Replacement
TOTAL EST. ANNUAL (ROOF) ENERGY SAVINGS - (CONDUCTION & SOLAR)		
Estimated Annual (Conduction) Energy Cost Savings	\$0	\$0
Estimated Annual (Solar Insulation) Energy Cost Savings	\$6,470	\$0
Total Estimated Annual Energy Cost Savings	\$6,470	\$0
PROPOSED - COMBINED PROJECT FINANCIALS		
Initial Project Value (Year 0)	-\$3,298,000	-\$2,830,435
Total Project Value (20-Year)	-\$3,298,000	-\$2,830,435
Total Project Value (40-Year)	-\$3,298,000	-\$27,252,708
Annual (Canam) Energy Savings (Building Weatherization)	\$0	\$0
Annual (T-138 Retrofit) Cost Avoidance Savings	\$719,030	\$0
Estimated Annual Maintenance Savings	\$0	\$0
Combined Annual Savings (Including Roof Analysis)	\$725,500	\$0
TOTAL PROJECT SAVINGS (Over 40 Years)	\$24,681,059	\$0
TOTAL PROJECT PAYMENTS (Over 40-Years)	-\$3,298,000	\$0
Net Present Value (at Year 20)	-\$1,719,956	-\$6,124,394
Net Present Value (at Year 40)	\$2,562,422	-\$17,111,923
Simple Payback (at Year 20)	510	None
Simple Payback (at Year 40)	5.3	None





ENERGY SAVINGS:

During the winter months, cool or light-colored roofs increase the need for heating energy in cold climates because they absorb less of the sun's radiant energy. However, during the winter the sun is lower in the sky, the days are shorter, and the skies are increased cloudy, limiting the amount of sunlight (solar radiation) available to a roof. In addition, when snow covers the roof, the color of the roof beneath the snow becomes irrelevant. In the United States, this winter heating penalty is typically small compared to the summer cooling benefit.

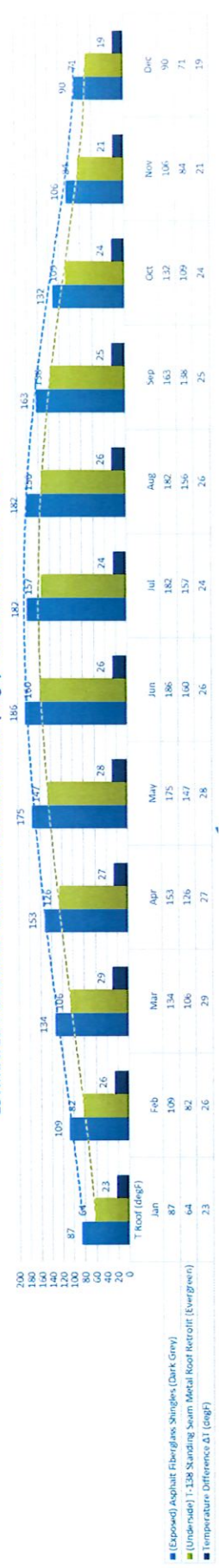
HEATING PENALTY vs. ENERGY SAVINGS

The cooling energy cost savings from cool roofs should outweigh the winter heating penalty in all but the very northern-most locations in the US (source: Levinson and Akbari 2010).

Below chart, shows the estimated annual heating penalty vs cooling savings for your project and the estimated average monthly peak roof surface temperature (see graph).

ESTIMATED ENERGY SAVINGS DUE TO SOLAR RADIANT ENERGY REDUCTION	
Annual Cooling Energy Savings:	558,117,204 BTU-h/Year
Conversion to kWh & COP (3413 BTU/kWh)	58,585 kWh/Year
Estimated Cooling Energy Savings	\$7,452.03 \$/Year
Estimated Demand Savings (kW)	14.9 kW
Estimated Annual Demand Cost Savings (\$/yr)	\$0.00 \$/Year
Combined Annual Cooling Energy Savings (\$/yr)	\$7,452.03 \$/Year
Annual Heating Energy Savings:	-98,981,027 BTU-h/Year
Conversion to Therms & Eff. (100,000 BTU/Therms)	-1,237 Therms/Year
Estimated Heating Energy Savings	-\$982.39 \$/Year
TOTAL ESTIMATED ANNUAL COST SAVINGS (\$)	\$6,469.64 \$/Year

ESTIMATED PEAK ROOF SURFACE TEMPERATURES (degF) - EXISTING vs PROPOSED

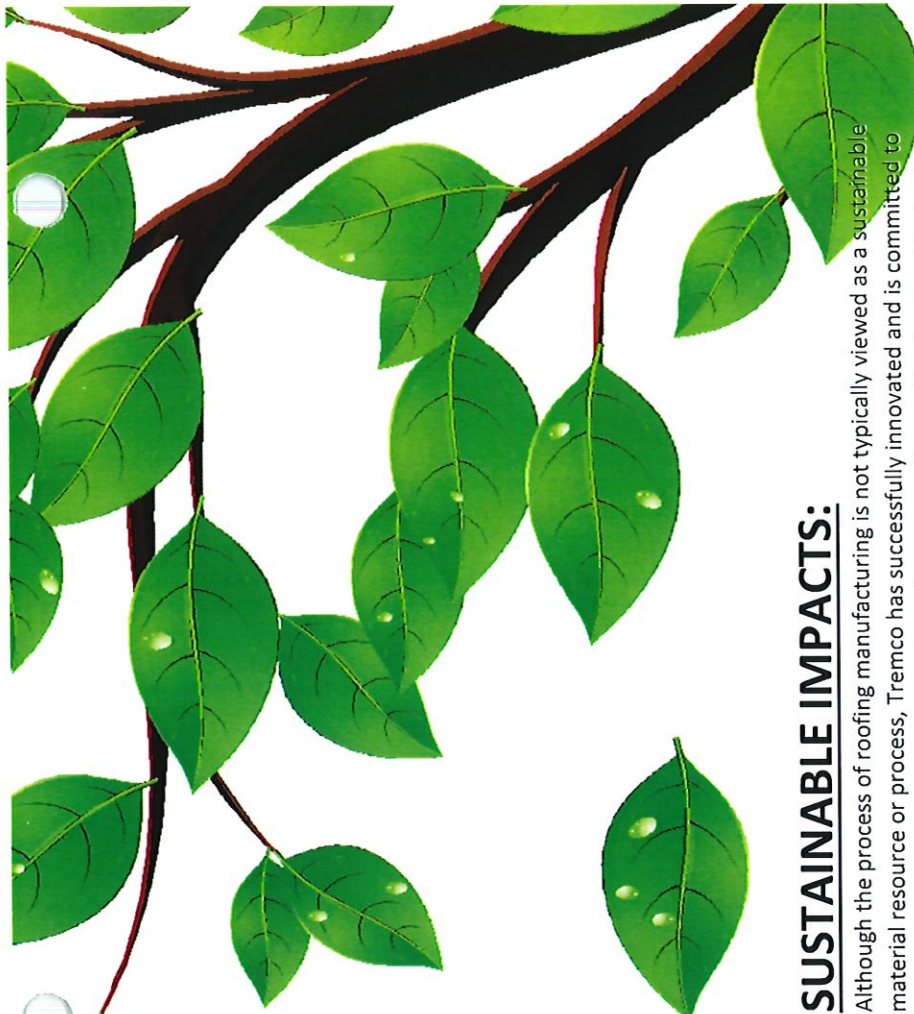




POTENTIAL / BENEFITS

Substituting a Tremlock T-138 Standing seam metal roof for traditional asphalt shingle roof can provide benefits for your facility.

	TREMLOCK T-138 RETROFIT	ASPHALT SHINGLES
Project Value/Cost <i>(over 40-year period)</i>	Although the initial project cost may be higher, life cycle analysis reveals that the proposed Tremlock is less expensive.	Has lower initial project cost, but the repeating cycle of future shingle replacements yields a higher cost of ownership.
Project Savings <i>(over 40-year period)</i>	Tremlock T-138 system yields higher project savings <i>(i.e. energy and cost avoidance of future shingle replacements)</i>	NONE.
Lifecycle	60-years +	Typically, per warranty 15 to 20-years
Warranty	Full Tremco 20-year labor and material leak free warranty with a 30-year finish warranty	Industry standard 2-year labor warranty. Warranty on material is prorated and excludes most commercial applications.
Aesthetics	Potential to increase curbside appeal and overall building value	Same as existing
Energy Savings	YES	NONE
Landfill Diversion	YES, no shingles in the landfill.	NO, repeating cycle of shingle replacements every 15 to 20-years
Wind Uplift Resistance	Excellent, testing up to 300 lbs. per SF <i>(Potential for reduced insurance premium)</i>	POOR
Ice Damming	Greatly Reduced	YES
CO2 Greenhouse Gas Reduction	YES	NONE
Problems with the installation and mounting of Solar Panels	NONE, the solar panel structure is clamped directly to the standing-seam's ribs with no added support or penetrations of the water barrier.	YES, the supporting solar structure will have hundreds of added penetrations through the shingles (water barrier) which are potential future leaks
Problems with future repairs or added penetrations	NONE, individual panel replaceability. The metal panels can be removed and replaced if damaged or new penetrations are added.	NONE, shingles can be removed and replaced as needed.
Can the system handle building expansion and contraction	YES, the system is designed to move with building expansion and contraction	NO, shingles do not handle building movement very well and will split
Added Plywood Deck Replacement Cost	Minimal if anything at all. The new metal roof is attached directly to roof structural supports.	YES, all compromised vented plywood decking needs to be removed and replaced. The shingles are fastened into the plywood.
Existing Shingle Tear Off Required	No tear off is required. New metal roof is installed over existing shingles. No shingles to landfill.	Full shingle tear-off is required. All existing shingles go to landfill.



"Tremco T-138" Roof Retrofit

GREENHOUSE GAS EQUIVALENCIES - ANNUAL CO2 SAVINGS FROM ENERGY SAVINGS		
COOLING ENERGY SAVINGS		
Total Combined Annual kWh/Year Savings	58,585 kWh/Year	Conversions: 7.03 x 10 ⁻⁴ metric tons CO ₂ /kWh
Annual lbs of CO ₂ Saved	90,798 lbs/Year	
HEATING ENERGY SAVINGS		
Total Combined Annual Therms/Year Savings	-1,237 Therms/Year	Conversions: 0.005302 metric tons CO ₂ /Therms
Annual lbs of CO ₂ Saved	-14,462 lbs/Year	
TOTAL ANNUAL CO₂ SAVINGS FROM ENERGY SAVINGS =	76,336 lbs of CO₂ Saved per Year	or 3,053,431 lbs of CO₂ Saved Over A 40-Year Period

CALCULATIONS FOR REDUCTION OF MATERIAL TO THE NOT GOING TO LANDFILL			
ROOFING MATERIAL	MATERIAL DENSITY	MATERIAL VOLUME	MATERIAL WEIGHT (lbs)
	X	=	=
	X	=	=
	X	=	=
	X	=	=
MATERIAL UNIT WEIGHT	MATERIAL AREA		
3.00 lbs/ft ³	X 150,000 sf		450,000 lbs
(of material not going to landfill) Total Tons =			225.0 tons

CALCULATIONS FOR CO ₂ REDUCTION FOR ROOF MATERIALS NOT INSTALLED (I.E. AVOIDED REPLACEMENT)					
ROOFING MATERIAL	EMBODED UNIT ENERGY	WEIGHT/ft ³	AREAS(ft ²)	CONVERSION	EMBODED ENERGY SAVED
	X	X	=	=	=
	X	X	=	=	=
	X	X	=	=	=
	X	X	=	=	=
	X	X	=	=	=
	X	X	=	=	=
	X	X	=	=	=
	X	X	=	=	=
	X	X	=	=	=
Total	0 MJ	X 0.278-kWh / 1-MJ	X 1.5-HI	0 lbs of CO₂ (one time occurrence)	0 MJ

Asphalt Roof Shingle Replacement

GREENHOUSE GAS EQUIVALENCIES - ANNUAL CO2 SAVINGS FROM ENERGY SAVINGS		
COOLING ENERGY SAVINGS		
Total Combined Annual kWh/Year Savings	0 kWh/Year	
Annual lbs of CO ₂ Saved	0 lbs/Year	
HEATING ENERGY SAVINGS		
Total Combined Annual Therms/Year Savings	0 Therms/Year	
Annual lbs of CO ₂ Saved	0 lbs/Year	
TOTAL ANNUAL CO₂ SAVINGS FROM ENERGY SAVINGS =	0 lbs of CO₂ Saved per Year	or 0 lbs of CO₂ Saved Over A 40-Year Period

CALCULATIONS FOR REDUCTION OF MATERIAL TO THE NOT GOING TO LANDFILL			
ROOFING MATERIAL	MATERIAL DENSITY	MATERIAL VOLUME	MATERIAL WEIGHT (lbs)
	X	=	=
	X	=	=
	X	=	=
	X	=	=
MATERIAL UNIT WEIGHT	MATERIAL AREA		
X	X 150,000 sf		=
(of material not going to landfill) Total Tons =			0 tons

CALCULATIONS FOR CO ₂ REDUCTION FOR ROOF MATERIALS NOT INSTALLED (I.E. AVOIDED REPLACEMENT)					
ROOFING MATERIAL	EMBODED UNIT ENERGY	WEIGHT/ft ³	AREAS(ft ²)	CONVERSION	EMBODED ENERGY SAVED
	X	X	=	=	=
	X	X	=	=	=
	X	X	=	=	=
	X	X	=	=	=
	X	X	=	=	=
	X	X	=	=	=
	X	X	=	=	=
	X	X	=	=	=
Total	0 MJ	X 0.278-kWh / 1-MJ	X 1.5-HI	0 lbs of CO₂ (one time occurrence)	0 MJ

SUSTAINABLE IMPACTS:

Although the process of roofing manufacturing is not typically viewed as a sustainable material resource or process, Tremco has successfully innovated and is committed to future roofing and building materials, and processes (i.e. roof restoration) that extend the life cycle of building materials. In addition, Tremco also expands on its sustainable promise with supporting programs (i.e. cool roof (white), vegetative roofing, Canam building weatherization, High Performance Building Solutions (energy audits/retrofits), Indoor Air Quality solutions and Zero Land Fill programs).

Left side chart, shows the estimated annual greenhouse gas equivalencies in CO2 savings for your project as compared to an asphalt shingle roof replacement.



TREMCO

ROOFING & BUILDING MAINTENANCE

ROOF FINANCIAL ANALYSIS - EXECUTIVE SUMMARY

Ann A. Mullen Middle School **"Tremlock T-138" Roof Retrofit** **Asphalt Roof Shingle Replacement**

TOTAL EST. ANNUAL (ROOF) ENERGY SAVINGS - (CONDUCTION & SOLAR)	
Estimated Annual (Conduction) Energy Cost Savings	\$0
Estimated Annual (Solar Insulation) Energy Cost Savings	\$6,470
Total Estimated Annual Energy Cost Savings	\$6,470

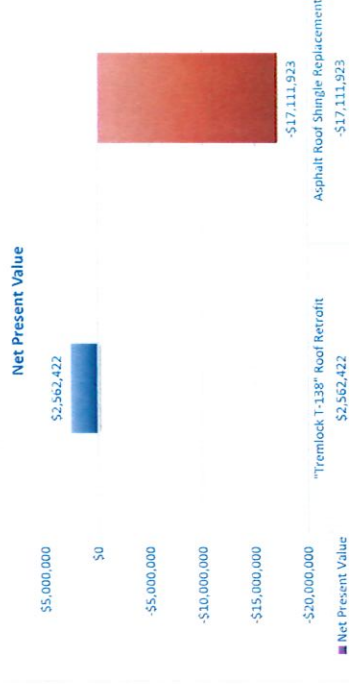
PROPOSED - COMBINED PROJECT FINANCIALS	
Initial Project Value (Year 0)	-\$2,830,435
Total Project Value (20-Year)	-\$3,298,000
Total Project Value (40-Year)	-\$27,252,708

Annual (Cinam) Energy Savings (Building Weatherization)	\$0
Annual (T-138 Retrofit) Cost Avoidance Savings	\$719,030
Estimated Annual Maintenance Savings	\$0
Combined Annual Savings (Including Roof Analysis)	\$725,500

TOTAL PROJECT SAVINGS (Over 40-Years)	\$24,681,059
TOTAL PROJECT PAYMENTS (Over 40-Years)	-\$3,298,000

Net Present Value (at Year 20)	-\$6,124,394
Net Present Value (at Year 40)	-\$17,111,923

Simple Payback (at Year 20) **None**
 Simple Payback (at Year 40) **None**



PROJECT DATA & ASSUMPTIONS
 Estimated Financed (T-138) Retrofit Cost (Over 10-ys) **\$3,298,000**
 "Tremlock T-138" Roof Retrofit **\$3,298,000**

Roof Loan Term (Years) 10 Years
 Project Roof Area (Square Feet) 150,000 SF
 Annual Discount Rate 5%
 Annual Interest Rate 0%
 Annual (Assumed) Price Inflation Rate 6.00%
 Assumed T-138 Roof Retrofit Loan Term (Years) 10 Years

Est. (Asphalt Shingles) Roof Replacement Cost (at year 16) **\$7,190,300**
 Est. (Asphalt Shingles) Roof Replacement Cost (at year 31) **\$17,231,973**
 Estimated T-138 Roof Retrofit Cost (at year 20) **\$0**
 Estimated Canam Retrofit Cost **\$0**
PROPOSED TOTAL PROJECT COST \$3,298,000

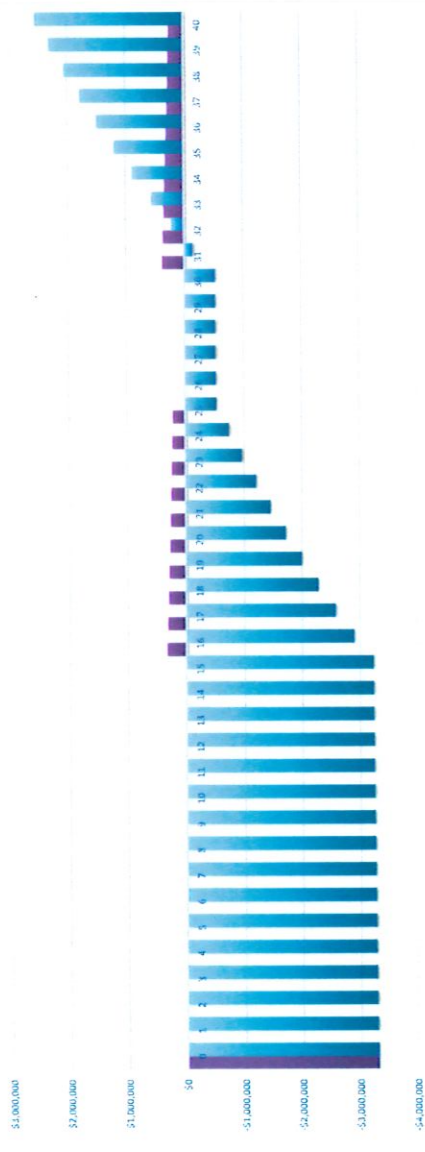
MAINTENANCE SAVINGS CALCULATIONS
 Estimated Maintenance Cost Savings/SF **\$0.00 SF/Year**

ENERGY SAVINGS CALCULATIONS
 Estimated Annual Roof Energy Savings **\$6,470 /Year**
 Estimated Annual Canam Energy Savings **\$0 /Year**

RESTORATION COST AVOIDANCE SAVINGS CALCULATIONS
 Est. 3rd (Asphalt Shingles) Replacement Cost with Financing **\$7,190,300**
 Est. 3rd (T-138) Roof Retrofit Costs with Financing **\$0**
 Estimated 3rd Annual Cost Avoidance Savings **\$719,030 /Year**
TOTAL COMBINED SAVINGS \$725,500 /Year

EST. 3rd (Asphalt Shingles) Replacement Cost with Financing \$7,190,300
EST. 3rd (T-138) Roof Retrofit Costs with Financing \$0
ESTIMATED 3rd ANNUAL COST AVOIDANCE SAVINGS \$719,030 /Year
TOTAL COMBINED SAVINGS \$725,500 /Year

Project - Net Present Value (NPV)



Year	Project Cost	Combined Project Savings	Payments w/ Interest	Net Customer Savings	Present Value	Accumulated Present Value
0	-\$3,298,000	\$0	\$0	-\$3,298,000	-\$3,298,000	-\$3,298,000
1	\$6,470	\$6,470	\$0	\$6,470	\$6,162	-\$3,291,838
2	\$6,470	\$6,470	\$0	\$6,470	\$5,888	-\$3,285,970
3	\$6,470	\$6,470	\$0	\$6,470	\$5,589	-\$3,280,382
4	\$6,470	\$6,470	\$0	\$6,470	\$5,233	-\$3,275,059
5	\$6,470	\$6,470	\$0	\$6,470	\$5,009	-\$3,269,990
6	\$6,470	\$6,470	\$0	\$6,470	\$4,828	-\$3,265,102
7	\$6,470	\$6,470	\$0	\$6,470	\$4,598	-\$3,260,504
8	\$6,470	\$6,470	\$0	\$6,470	\$4,379	-\$3,256,185
9	\$6,470	\$6,470	\$0	\$6,470	\$4,170	-\$3,252,015
10	\$6,470	\$6,470	\$0	\$6,470	\$3,972	-\$3,248,043
11	\$6,470	\$6,470	\$0	\$6,470	\$3,783	-\$3,244,260
12	\$6,470	\$6,470	\$0	\$6,470	\$3,603	-\$3,240,658
13	\$6,470	\$6,470	\$0	\$6,470	\$3,431	-\$3,237,227
14	\$6,470	\$6,470	\$0	\$6,470	\$3,268	-\$3,233,959
15	\$6,470	\$6,470	\$0	\$6,470	\$3,112	-\$3,230,847
16	\$725,500	\$725,500	\$0	\$725,500	\$332,360	-\$2,898,488
17	\$725,500	\$725,500	\$0	\$725,500	\$316,533	-\$2,881,954
18	\$725,500	\$725,500	\$0	\$725,500	\$301,460	-\$2,866,494
19	\$725,500	\$725,500	\$0	\$725,500	\$287,105	-\$1,993,390
20	\$725,500	\$725,500	\$0	\$725,500	\$273,433	-\$1,719,956 NPV
21	\$725,500	\$725,500	\$0	\$725,500	\$260,413	-\$1,459,544
22	\$725,500	\$725,500	\$0	\$725,500	\$248,012	-\$1,211,532
23	\$725,500	\$725,500	\$0	\$725,500	\$236,202	-\$975,330
24	\$725,500	\$725,500	\$0	\$725,500	\$224,954	-\$750,376
25	\$725,500	\$725,500	\$0	\$725,500	\$214,242	-\$536,134
26	\$6,470	\$6,470	\$0	\$6,470	\$1,820	-\$534,314
27	\$6,470	\$6,470	\$0	\$6,470	\$1,733	-\$532,581
28	\$6,470	\$6,470	\$0	\$6,470	\$1,650	-\$530,931
29	\$6,470	\$6,470	\$0	\$6,470	\$1,572	-\$529,359
30	\$6,470	\$6,470	\$0	\$6,470	\$1,497	-\$527,862
31	\$1,729,667	\$1,729,667	\$0	\$1,729,667	\$381,149	-\$146,714
32	\$1,729,667	\$1,729,667	\$0	\$1,729,667	\$362,999	\$216,285
33	\$1,729,667	\$1,729,667	\$0	\$1,729,667	\$345,713	\$561,998
34	\$1,729,667	\$1,729,667	\$0	\$1,729,667	\$329,250	\$891,248
35	\$1,729,667	\$1,729,667	\$0	\$1,729,667	\$313,572	\$1,204,820
36	\$1,729,667	\$1,729,667	\$0	\$1,729,667	\$298,640	\$1,503,460
37	\$1,729,667	\$1,729,667	\$0	\$1,729,667	\$284,419	\$1,787,879
38	\$1,729,667	\$1,729,667	\$0	\$1,729,667	\$270,875	\$2,058,754
39	\$1,729,667	\$1,729,667	\$0	\$1,729,667	\$257,976	\$2,316,730
40	\$1,729,667	\$1,729,667	\$0	\$1,729,667	\$245,692	\$2,562,422 NPV
Total Project Value	-\$3,298,000	\$24,681,059	\$0	\$0		

PROJECT FINANCIAL ANALYSIS

NET PRESENT VALUE (at Year 20) (\$1,719,856)
NET PRESENT VALUE (at Year 40) \$2,562,422
TOTAL PROJECT SAVINGS (Over 40 Years) \$24,681,059
TOTAL PROJECT PAYMENTS (Over 40 Years) -\$3,298,000

ESTIMATED SIMPLE PAYBACK (YEARS) 5.3
 (Based on average annual savings)

PROJECT FINANCIAL SUMMARY

NET PRESENT VALUE (at Year 20) (\$1,719,856)
NET PRESENT VALUE (at Year 40) \$2,562,422
TOTAL PROJECT SAVINGS (Over 40 Years) \$24,681,059
TOTAL PROJECT PAYMENTS (Over 40 Years) -\$3,298,000

ESTIMATED SIMPLE PAYBACK (YEARS) 5.3
 (Based on average annual savings)

PROJECT DATA & ASSUMPTIONS

Asphalt Roof Shingle (Initial) Replacement Cost **\$2,830,435** 10 Years
 Warranty Period & Replacement Load Term (Years)
 Project Roof Area (Square Feet) **150,000 SF**
 Annual Interest Rate **5%**
 Annual (Assumed) Price Inflation Rate **0%**
 Annual Discount Rate **6.00%**

Est. (Asphalt Shingle) Roof Replacement Cost (at Year 16) **\$7,190,300**
 Est. (Asphalt Shingle) Roof Replacement Cost (at Year 31) **\$17,231,973**

Estimated Combined Savings **\$0**
PROPOSED TOTAL PROJECT COST **\$10,020,735**

MAINTENANCE SAVINGS CALCULATIONS

Estimated Maintenance Cost Savings/SF **\$0.00 SF/Year**
 Estimated Annual Maintenance Savings **\$0 /Year**

ENERGY SAVINGS CALCULATIONS

Estimated Annual Roof Energy Savings **\$0 /Year**
 Estimated Annual Canam Energy Savings **\$0 /Year**

TOTAL COMBINED SAVINGS **\$0 /Year**

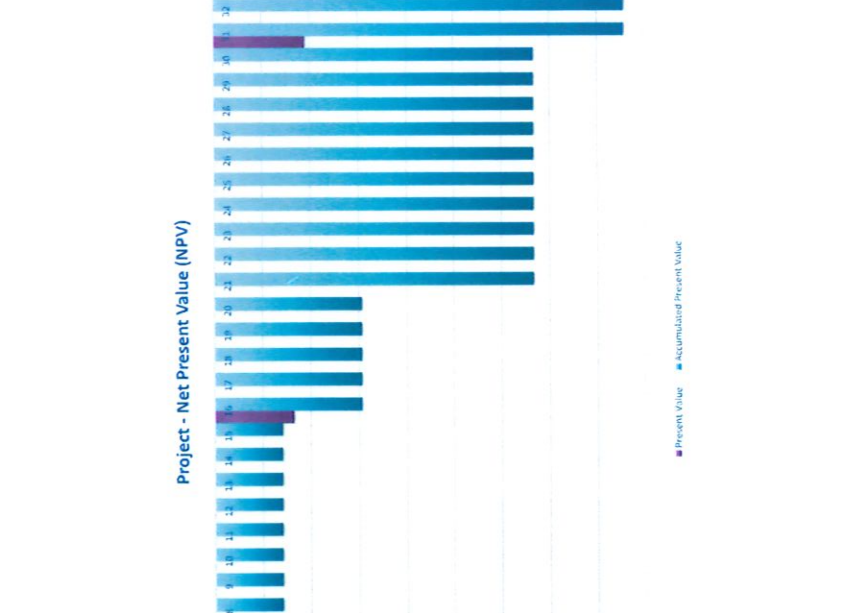
PROJECT FINANCIAL ANALYSIS

Year	Project Cost	Comined Project Savings	Payments w/ Interest	Net Customer Savings	Present Value	Accumulated Present Value
0	-\$2,830,435	\$0	\$0	-\$2,830,435	-\$2,830,435	-\$2,830,435
1	Shingle Replacement #1	\$0	\$0	\$0	\$0	-\$2,830,435
2		\$0	\$0	\$0	\$0	-\$2,830,435
3		\$0	\$0	\$0	\$0	-\$2,830,435
4		\$0	\$0	\$0	\$0	-\$2,830,435
5		\$0	\$0	\$0	\$0	-\$2,830,435
6		\$0	\$0	\$0	\$0	-\$2,830,435
7		\$0	\$0	\$0	\$0	-\$2,830,435
8		\$0	\$0	\$0	\$0	-\$2,830,435
9		\$0	\$0	\$0	\$0	-\$2,830,435
10		\$0	\$0	\$0	\$0	-\$2,830,435
11		\$0	\$0	\$0	\$0	-\$2,830,435
12		\$0	\$0	\$0	\$0	-\$2,830,435
13		\$0	\$0	\$0	\$0	-\$2,830,435
14		\$0	\$0	\$0	\$0	-\$2,830,435
15		\$0	\$0	\$0	\$0	-\$2,830,435
16	-\$7,190,300	\$0	\$0	-\$7,190,300	-\$3,293,959	-\$6,124,394
17	Shingle Replacement #2	\$0	\$0	\$0	\$0	-\$6,124,394
18		\$0	\$0	\$0	\$0	-\$6,124,394
19		\$0	\$0	\$0	\$0	-\$6,124,394
20		\$0	\$0	\$0	\$0	-\$6,124,394
21		\$0	\$0	\$0	\$0	-\$6,124,394
22		\$0	\$0	\$0	\$0	-\$6,124,394
23		\$0	\$0	\$0	\$0	-\$6,124,394
24		\$0	\$0	\$0	\$0	-\$6,124,394
25		\$0	\$0	\$0	\$0	-\$6,124,394
26		\$0	\$0	\$0	\$0	-\$6,124,394
27		\$0	\$0	\$0	\$0	-\$6,124,394
28		\$0	\$0	\$0	\$0	-\$6,124,394
29		\$0	\$0	\$0	\$0	-\$6,124,394
30		\$0	\$0	\$0	\$0	-\$6,124,394
31	-\$17,231,973	\$0	\$0	-\$17,231,973	-\$3,797,229	-\$17,111,923
32	Shingle Replacement #3	\$0	\$0	\$0	\$0	-\$17,111,923
33		\$0	\$0	\$0	\$0	-\$17,111,923
34		\$0	\$0	\$0	\$0	-\$17,111,923
35		\$0	\$0	\$0	\$0	-\$17,111,923
36		\$0	\$0	\$0	\$0	-\$17,111,923
37		\$0	\$0	\$0	\$0	-\$17,111,923
38		\$0	\$0	\$0	\$0	-\$17,111,923
39		\$0	\$0	\$0	\$0	-\$17,111,923
40		\$0	\$0	\$0	\$0	-\$17,111,923
Total Project Value	-\$27,257,708	\$0	\$0	\$0	\$0	-\$27,257,708

\$2,830,435
\$385,044

\$7,190,300
\$725,030

\$17,231,973
\$1,723,197



PROJECT FINANCIAL SUMMARY

NET PRESENT VALUE (at Year 20)	(\$6,124,394)
NET PRESENT VALUE (at Year 40)	(\$17,111,923)
TOTAL PROJECT SAVINGS (Over 40-Years)	\$0
TOTAL PROJECT PAYMENTS (Over 40-Years)	\$0
ESTIMATED SIMPLE PAYBACK (YEARS)	None

ENERGY CALCULATIONS

PROJECT: Ann A. Mullen Middle School - "Tremlock T-138" Roof Retrofit
LOCATION: Philadelphia, Pennsylvania International AP (Bin Hour Weather Data)
ADDRESS: 1400 Sicklerville Road, Sicklerville, NJ 08081
TREMCO REP: Robert Hamersky

PROJECT INFORMATION	
Roof Area:	150,000 SF
Cost of Electric	\$0.127 \$/KWH
Cost of Natural Gas:	\$0.79 \$/Therm
Electric Heat Conversion → \$/KWh to \$/Therm	None
Assumed Interior Temperature (Deg-F) for Heating & Cooling	
Heating System Assumed Efficiency (Value 0 to 1.0)	70
Cooling System Assumed Efficiency	0.80
Demand Charges per KW (if Available) (@ 6-months duration)	2.79
Project Type Roof (Restoration or Replacement?)	Replacement

ROOF DATA

	EXISTING ROOF DATA - (R-VALUES)		PROPOSED ROOF DATA - (R-VALUES)	
	Summer	Winter	Summer	Winter
Interior Air Film	0.92	0.61	0.92	0.61
Exterior Air Film	0.25	0.17	0.25	0.17
Substrate/Deck:	0.00	0.00	0.00	0.00
Insulation	18.4	18.4	18.4	18.4
Roof Membrane:	0.44	0.44	0.44	0.44
Sum R-Value	20.0	19.6	20.0	19.6
Average R-Value		19.8		19.8

	EXISTING ROOF DATA - (R-VALUES)		PROPOSED ROOF DATA - (R-VALUES)	
	Summer	Winter	Summer	Winter
Interior Air Film	0.92	0.61	0.92	0.61
Exterior Air Film	0.25	0.17	0.25	0.17
Substrate/Deck:	0.00	0.00	0.00	0.00
Insulation	18.4	18.4	18.4	18.4
Roof Membrane:	0.44	0.44	0.44	0.44
Sum R-Value	20.0	19.6	20.0	19.6
Average R-Value		19.8		19.8

SOLAR ENERGY DATA

	EXISTING ROOF DATA - (SOLAR VALUES)		PROPOSED ROOF DATA - (SOLAR VALUES)	
	Material/Color	3-yr (Weathered) Value (%)	Material/Color	3-yr (Weathered) Value (%)
Solar Reflectance	(Exposed) Asphalt Fiberglass Shingles (Dark Grey)	8	(Exposed) Asphalt Fiberglass Shingles (Dark Grey)	8
Thermal Emittance		91		91
Solar Reflectance	(Underside) T-138 Standing Seam Metal Roof Retrofit (Evergreen)	26	(Underside) T-138 Standing Seam Metal Roof Retrofit (Evergreen)	26
Thermal Emittance		84		84

TOTAL ESTIMATED ANNUAL (ROOF) ENERGY SAVINGS (Conduction, Convection & Solar)	
Estimated Annual (Conduction) Energy Cost Savings	\$0
Estimated Annual (Solar Insolation) Energy Cost Savings	\$6,470
Total Estimated Annual Energy Cost Savings:	\$6,470

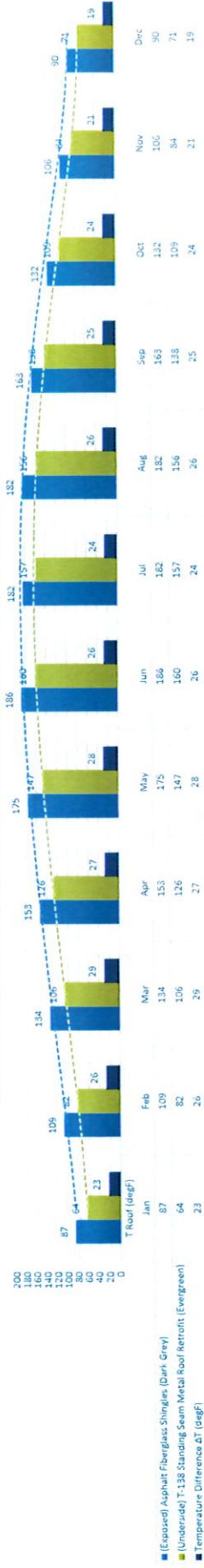
PROPOSED - COMBINED PROJECT FINANCIALS

Total Project Value (At Year 0)	\$3,298,000
Total Project Value (At Year 20)	\$3,298,000
Estimated Annual (CANAM) Energy Savings (Building Weatherization)	\$0
Estimated Annual (Restoration) Cost Avoidance Savings	\$0
Estimated Annual Maintenance Savings	\$0
Total Estimated (Combined) Annual Savings (Including Roof Energy Savings)	\$6,470
Net Present Value (At Year 10)	-\$3,248,043
Net Present Value (At Year 20)	-\$1,719,956

Simple Payback (Years)

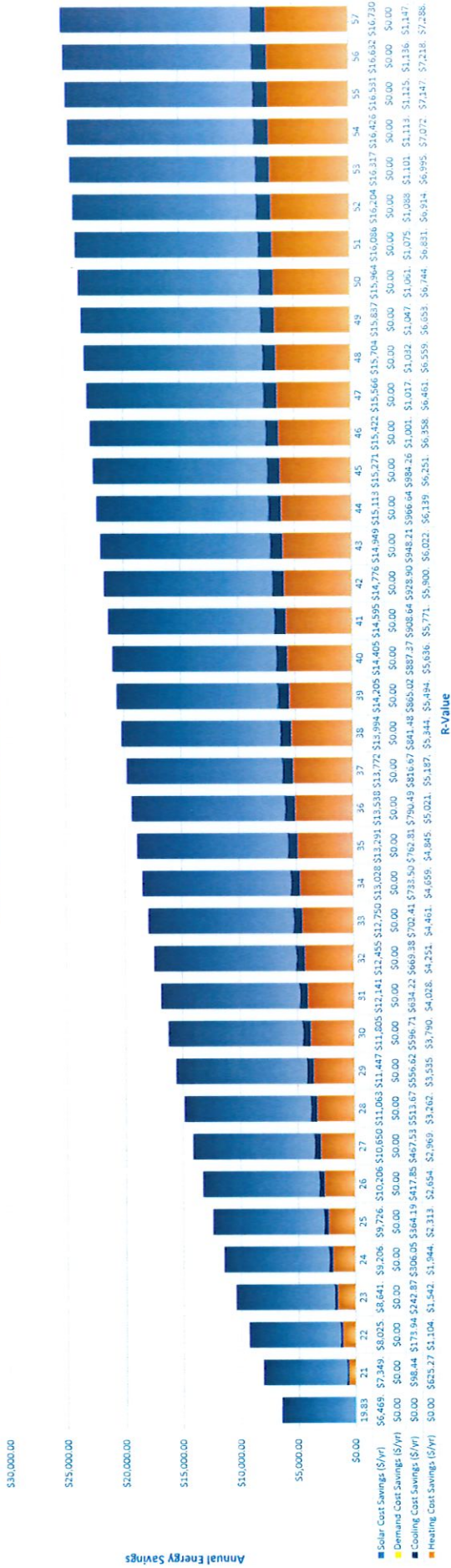
509.8

ESTIMATED PEAK ROOF SURFACE TEMPERATURES (degF) - EXISTING vs PROPOSED



ENERGY & FINANCIAL ANALYSIS

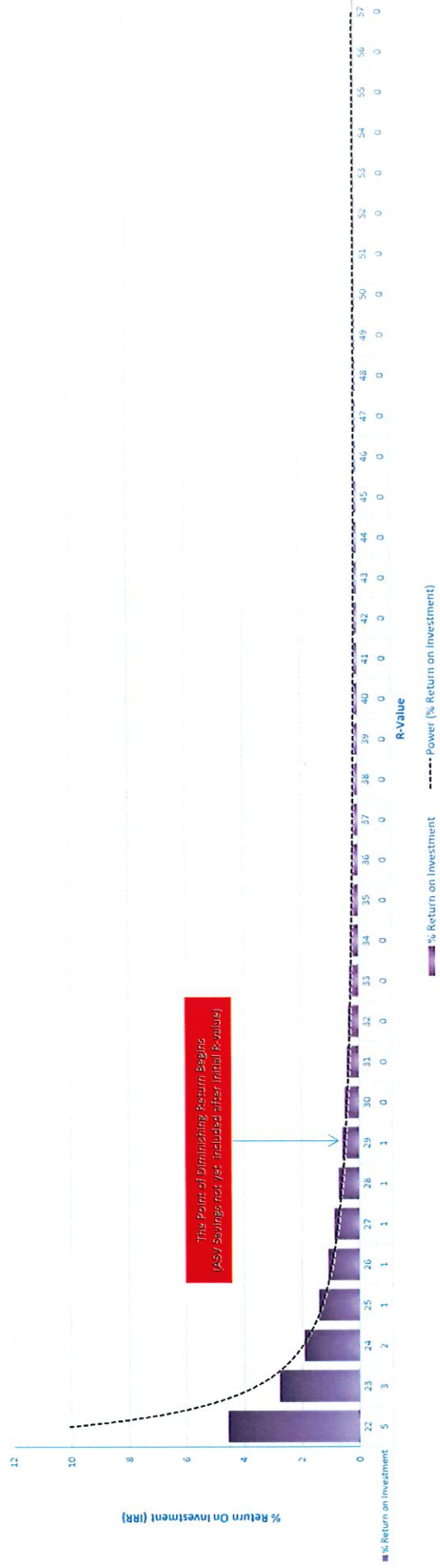
Annual Energy Savings vs. R-Value



Annual Solar Demand Savings is not yet included

The "Annual Energy Savings vs. R-Value" Graph shows how estimated annual energy savings varies with an increase in R-Value. Each annual savings is additionally broken down by components (i.e. heating, cooling demand cost and solar) savings. Graph can be used to determine area of optimal R-value, point of diminishing return for increased R-value, the equivalent R-value to solar/radiant energy savings.

% Return On Investment (IRR) vs R-Value



The Point of Diminishing Return Begins (ASJ) Savings has not included initial R-Value

Related to the "Annual Energy Savings vs. R-Value" above, the "% Return On Investment (IRR) vs R-Value" graph shows how the incremental change in the (a annual energy savings / initial project value) ratio varies with an increase in R-Value(s). Graph can be used to estimate the location of diminishing return and indicates that any additional thermal insulation beyond this point provides no financial incentive.

ENERGY CALCULATIONS

PROJECT: Ann A. Mullen Middle School - Asphalt Shingle Roof Replacement
LOCATION: Philadelphia, Pennsylvania International AP (Bin Hour Weather Data)
ADDRESS: 1400 Sicklerville Road, Sicklerville, NJ 08081
TREMCO REP: Robert Hamersky

PROJECT INFORMATION	
Roof Area:	150,000 SF
Cost of Natural Gas:	\$0.127 \$/KWH
<i>Electric Heat Conversion</i> → \$/KWh to \$/Therm	\$0.79 \$/Therm
Assumed Interior Temperature (Deg-F) for Heating & Cooling	None
Heating System Assumed Efficiency (Value 0 to 1.0)	Standard Boiler (Standard Flue)
Cooling System Assumed Efficiency	Air Cooled w/ Condensor
Demand Charges per KW (if Available) (@ 6-months duration)	70 Deg-F
Project Type Roof (Restoration or Replacement?)	Replacement

ROOF DATA

EXISTING ROOF DATA - (R-VALUES)	
Interior Air Film	Summer 0.92 Winter 0.61
Exterior Air Film	0.25 0.17
Substrate/Deck:	0.00 0.00
Insulation	18.4 18.4
Roof Membrane:	0.44 0.44
Sum R-Value	20.0 19.6

1.5" (22 Ga.) Steel Corrugated Roof Deck (R-0)	0.00 0.00
2.75" Polyisocyanurate Thermal Insulation (LTTR-5.56/m), (2-layers) 9/16" Oriented Standed Board (R-1.06/m), 3/4" Air Space (R-1.0)	18.4 18.4
Asphalt Fiberglass Shingles (R-0.44)	0.44 0.44
Sum R-Value	20.0 19.8

PROPOSED ROOF DATA - (R-VALUES)	
Interior Air Film	Summer 0.92 Winter 0.61
Exterior Air Film	0.25 0.17
Substrate/Deck:	0.00 0.00
Insulation	18.4 18.4
Roof Membrane:	0.44 0.44
Sum R-Value	20.0 19.6

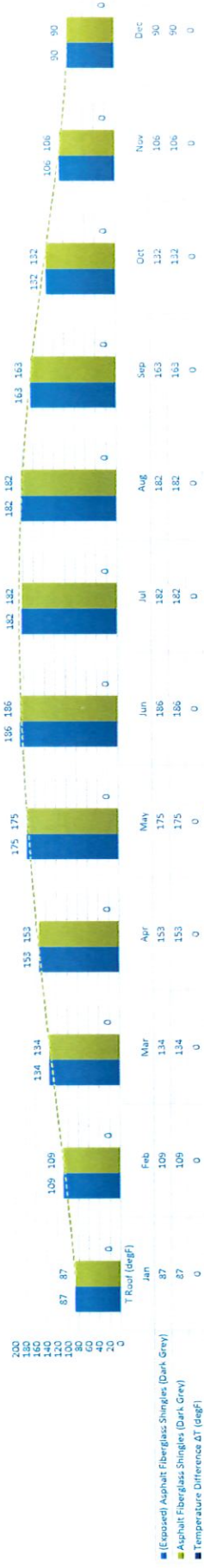
1.5" (22 Ga.) Steel Corrugated Roof Deck (R-0)	0.00 0.00
2.75" Polyisocyanurate Thermal Insulation (LTTR-5.56/m), (2-layers) 9/16" Oriented Standed Board (R-1.06/m), 3/4" Air Space (R-1.0)	18.4 18.4
Asphalt Fiberglass Shingles (R-0.44)	0.44 0.44
Sum R-Value	20.0 19.8

SOLAR ENERGY DATA

EXISTING ROOF DATA - (SOLAR VALUES)	
Material/Color	3-yr (Weathered) Value (%)
(Exposed) Asphalt Fiberglass Shingles (Dark Grey)	8
Thermal Emittance	91

PROPOSED ROOF DATA - (SOLAR VALUES)	
Material/Color	3-yr (Weathered) Value (%)
Asphalt Fiberglass Shingles (Dark Grey)	8
Thermal Emittance	91

ESTIMATED PEAK ROOF SURFACE TEMPERATURES (degF) - EXISTING vs PROPOSED



TOTAL ESTIMATED ANNUAL (ROOF) ENERGY SAVINGS (Conduction, Convection & Solar)	
Estimated Annual (Conduction) Energy Cost Savings	\$0
Estimated Annual (Solar Insolation) Energy Cost Savings	\$0
Total Estimated Annual Energy Cost Savings:	\$0

PROPOSED - COMBINED PROJECT FINANCIALS

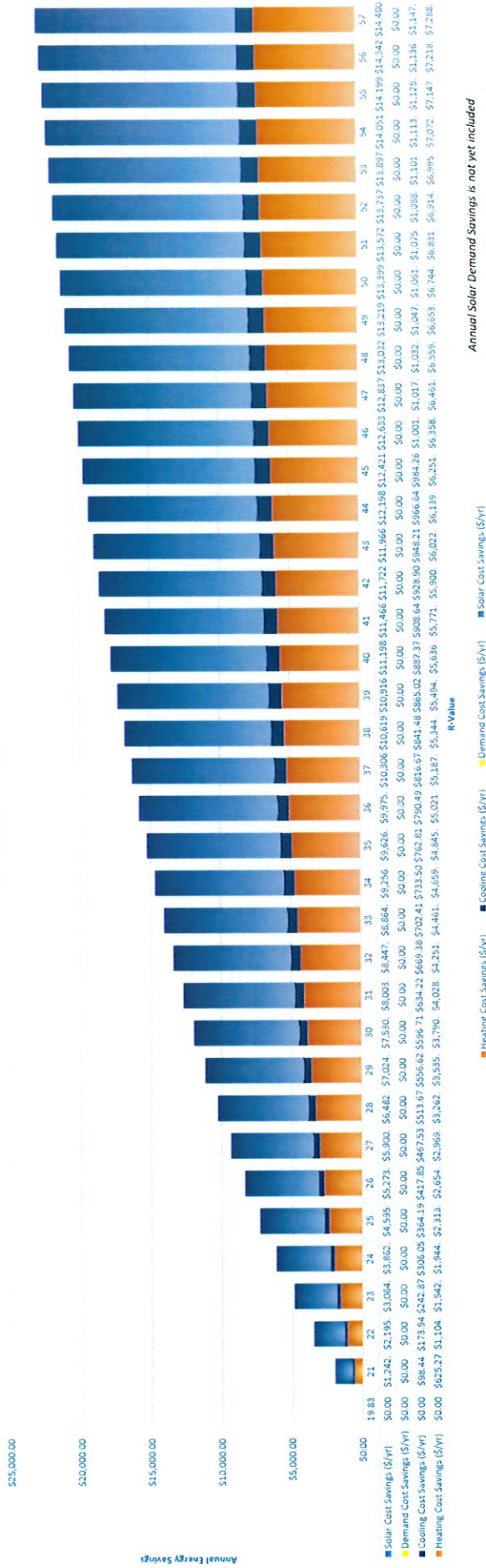
Total Project Value (At Year 0)	-\$2,830,435
Total Project Value (At Year 20)	-\$10,488,300
Estimated Annual (CANAM) Energy Savings (Building Weatherization)	\$0
Estimated Annual (Restoration) Cost Avoidance Savings	\$0
Estimated Annual Maintenance Savings	\$0
Total Estimated (Combined) Annual Savings (Including Roof Energy Savings)	\$0
Net Present Value (At Year 10)	-\$3,248,902
Net Present Value (At Year 20)	-\$1,721,343

Simple Payback (Years)

None

ENERGY & FINANCIAL ANALYSIS

Annual Energy Savings vs. R-Value



Annual Solar Demand Savings: is not yet included

The "Annual Energy Savings vs. R-Value" Graph shows how estimated annual energy savings varies with an increase in R-Value. Each annual savings is additionally broken down by components (i.e. heating, cooling demand cost and solar) savings. Graph can be used to determine: area of optimal R-value, point of diminishing return for increased R-value, the equivalent R-value to solar/radiant energy savings.

Δ Energy Savings vs R-Value



Related to the "Annual Energy Savings vs. R-Value" above, the "% Return On Investment (IRR) vs R-Value" graph shows how the incremental change in the (Δ annual energy savings / initial project value) ratio varies with an increase in R-Value(s). Graph can be used to estimate the location of diminishing return and indicates that any additional thermal insulation beyond this point provides no financial incentive.