SCALO SOLAR SOLUTIONS, LLC

SOLAR FEASIBILITY ANALYSIS

November 1st, 2013

PREFACE

The following analysis was conducted for the **Borough of Dormont** to determine whether the use of solar energy is feasible on the property known as the '*Dormont Pool and Recreation Center*'. This feasibility analysis included inspections of the existing roof conditions, electrical systems of the building, shade analysis readings, a summary of the utilities bills for this property, a financial analysis and a proposed layout.

This analysis is meant for evaluation purposes only and is not a quotation for any equipment, labor or any solicitation for business. Estimates included herein are for budgetary purposes only.
This analysis is offered to municipalities, institutions of higher learning and large nonprofit corporations to raise awareness in renewable energy and provide them the means to understand and evaluate the possibility of employing solar energy on their property or facilities.

No guarantee or warranty of any information provided, facility inspected, or assertion made is included or implied in this evaluation. This analysis is for informational purposes only.

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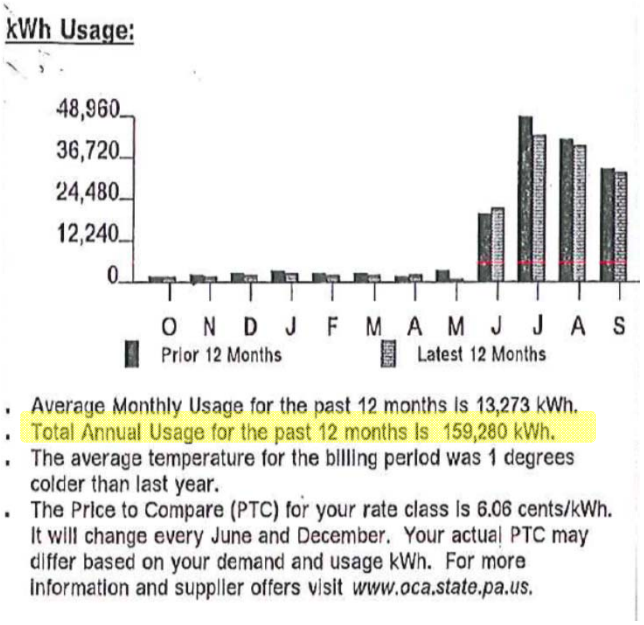
UTILITY ANALYSIS

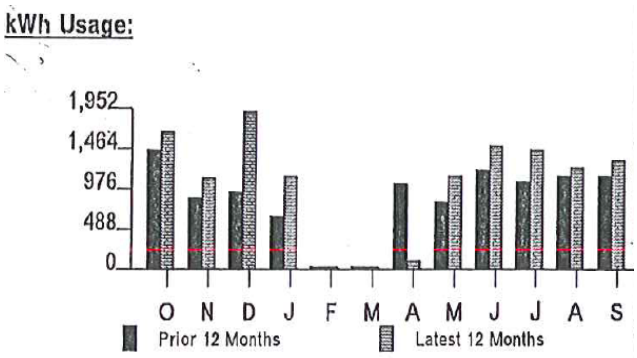
Before investing in renewable energy, it is recommended that you evaluate your current consumption of energy. Reducing consumption is by far the most efficient and cost effective method of saving energy. This analysis is based on current consumption for the Dormont Avenue property including the Recreation Center , Pool pumps and concession stand.

Electric bill from Rec Center and Pool



- Average Monthly Usage for the past 12 months is 13,273 kWh.
- Total Annual Usage for the past 12 months is 159,280 kWh.
- The average temperature for the billing period was 1 degrees colder than last year.
- The Price to Compare (PTC) for your rate class is 6.06 cents/kWh. It will change every June and December. Your actual PTC may differ based on your demand and usage kWh. For more information and supplier offers visit *www.oca.state.pa.us.*

Electric bill for Concession Stand



- Average Monthly Usage for the past 12 months is 1,080 kWh.
- Total Annual Usage for the past 12 months is 12,960 kWh.
- The average temperature for the billing period was 1 degrees colder than last year.
- The Price to Compare (PTC) for your rate class is 6.28 cents/kWh. It will change every June and December. Your actual PTC may differ based on your demand and usage kWh. For more information and supplier offers visit *www.PAPowerSwitch.com* & *www.oca.state.pa.us.*

REF: Duquesne Light Electricity Bills

Combined Annual Consumption in kilowatt-hours	159280 kWh + 12960 kWh **= 172,240 kWh**

The **kilowatt-hour**, (symbol **kWh**) is a unit of energy equal to 1000 watt-hours. It is the product of power in watts and time in hours. For example, running 10 x 100 watt light bulbs for one hour would constitute one kilowatt-hour. The kilowatt-hour is most commonly known as the billing unit for energy delivered to consumers by electric utilities.

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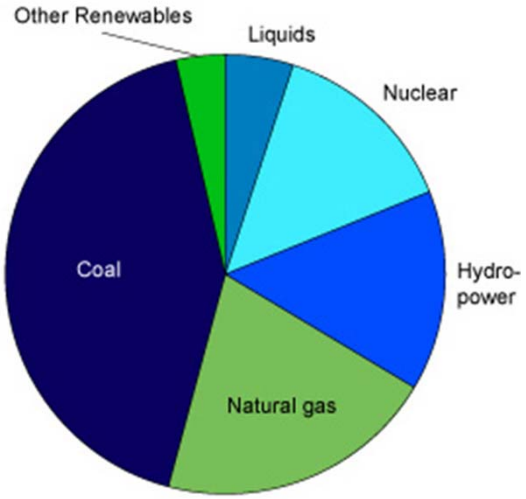
CARBON FOOTPRINT

A Communities *carbon footprint* is the sum of all emissions of greenhouse gases, like CO_2 (carbon dioxide) which were introduced into the environment during a given time frame. The burning of fossil fuels is the primary consideration in this analysis.

According to the U.S. Energy Information Administration, Pennsylvania generates 44 percent of its electricity from Coal. And it takes 1.07 lbs. of coal to generate one kilowatt-hour.



Pool & Rec Center energy consumption = **172,240 kilowatt-hours (kWh)**

This equals **184,296lbs**. or **92 tons of Coal** burned **Every Year**

Other CO2 Equivalents:

- 122 Metric Tons of CO_2
- 283 Barrels of Oil
- 5,063 Backyard Propane Cylinders
- 13,624 Gallons of Gasoline

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SOLAR EQUIVALENT

Renewable energy, specifically from solar photovoltaics (PV), is a zero-emission form of energy.
A single 3’ x 5’ solar module can produce 300 kWh’s annually. The industry standard warranty for these products is 25-years.

300 kWh x 25 year warranty = 7,500 kWh’s

The equivalent of solar energy required to produce the same 172,240 kWh of energy currently used in the analysis is approximately **153,786 watts of Solar PV**, or **154kW.**

One Solar Panel produces **7,500 kilowatt-hours (kWh)** over its rated life.

This equals 3-3/4 tons of coal

Month	Solar Radiation (kWh/day)	Energy (kWh)
1	2.49	9464
2	3.36	11568
3	4.20	15162
4	5.04	17528
5	5.45	18453
6	5.76	18550
7	5.58	18487
8	5.58	18479
9	4.65	15292
10	4.00	14132
11	2.52	8777
12	1.80	6348
Year	4.20	172240

This table shows the monthly production of solar energy produced by 154kW of installed capacity. Kilowatt-hours per meter-squared per day for each month and the expected kilowatt-hours produced each month. Not unexpectedly, the amount of generation over the summer months is much greater than winter months.

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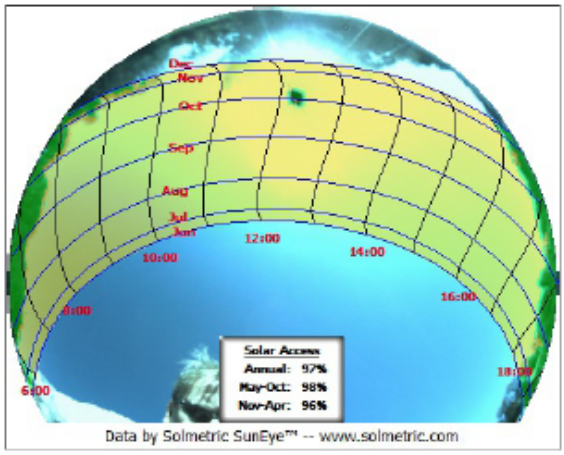
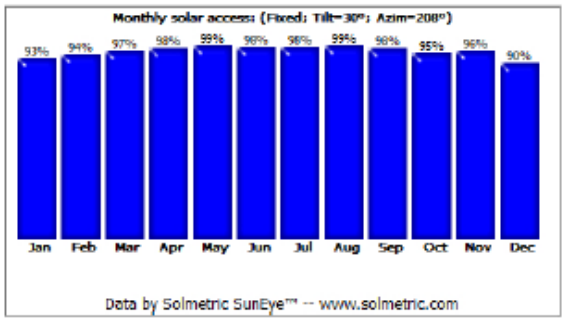
SHADE ANALYSIS

Shade can inhibit the amount of energy a solar panel can produce. It is necessary to properly place solar panels to maximize their access to the sun. Two readings were taken from either side of the recreation building. These measurements calculate the amount of sunlight the area will receive based on shading from surrounding structures, trees, rooftop equipment etc. A reading of 85% clear annual access to the sun is considered suitable by the PA DEP in relation to PA Sunshine programs. The west side of the building exhibited an 97% access. The east side of the building was 95%. The minor deviation is due to trees on the east side of the property.

West Side of Building

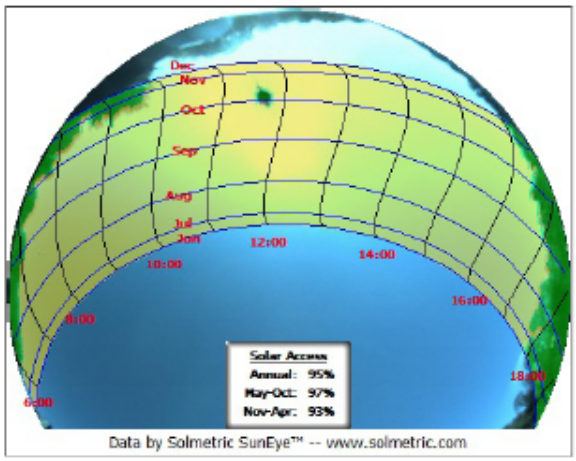
Panel Orientation: Tilt=30° -- Azimuth=208° -- **Skyline Heading=179°**
Solar Access: Annual: 97% -- Summer (May-Oct): 98% -- Winter (Nov-Apr): 96%
TSRF: 95% -- **TOF:** 98%

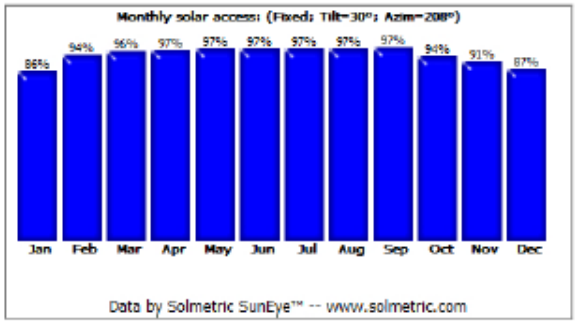




East Side of Building

Panel Orientation: Tilt=30° -- Azimuth=208° -- **Skyline Heading=179°**
Solar Access: Annual: 95% -- Summer (May-Oct): 97% -- Winter (Nov-Apr): 93%
TSRF: 93% -- **TOF:** 98%





SUMMARY

The resulting average of 96% clear access is well above average, and makes this location very suitable for solar energy production.

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EXISTING CONDITIONS REPORT

Evaluation of the existing conditions of the proposed site are absolutely necessary to ensure not only the long-term effectiveness of your investment in renewable energy, but more importantly the safety of those in the community.

In this analysis, the current conditions of the roof and existing electrical system were evaluated.

Prior to installation of any renewable energy equipment, a structural analysis should be performed by a licensed PE to ensure the structural capacity of the building.

Roof Condition Report

A roof inspection was conducted on October 21st ,2013. A copy of the full report is included herein under the appendix section.

Summary: The inspection report revealed that the roof is beyond its serviceable life and will be in need of replacement within 1-2 years. Borough maintenance on the roof has been obviously diligent and has extended the life of the roof well past its warranty. Due to the nature of solar having a 25-year production warranty, the roof conditions would need to be 'good' or 'excellent' to recommend placing solar equipment on the existing surface. Replacement of the roof would be necessary prior to installing any solar equipment.

Recommendations for replacing the roof with a white reflective TPO surface (Cool-Roof) and adding insulation up to current code requirements are included herein as additional methods for saving energy. (see Roof Life Cycle Savings Report in appendix)

EXISTING CONDITIONS REPORT CON'T

Electrical System Report

The integration of the solar equipment to the electrical system is highly important from a safety factor, but not substantial in scope. The inclusion of one breaker/disconnect to an existing electrical is typically all that is required. Batteries/storage for energy is no longer necessary as utility companies are required to allow for excess power to flow back to the grid when not needed. A simple assessment of the conditions of the current electrical system and size requirements is conducted, but no detailed report is necessary.

Summary: Existing conditions of the electrical system denote an outdated but operational system. Two separate services to the building currently exist; a three-phase service and a single-phase service. Both utilize 400 amp service-entrance disconnects that feed to additional equipment disconnects and one lighting panelboard through electrical wireways. Though the current conditions of the electrical system are functional, updating of the electrical equipment is suggested.

As is, the existing electrical system is suitable for a rooftop solar array only. In order to get the 154kW to power the entire facility, updating and upsizing of the service would be required.

A 154kW Solar PV System would yield a maximum output current of 417 amps at 208V, requiring a 600 amp line-side service disconnect.

Scalo Solar does not claim or warrant or the existence or absence of any particular electrical hazard in this analysis. Only the suitability of integrating solar into the existing equipment. Existing deficiencies may or may not be present and are not included in this analysis.

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PROPOSED SOLAR LAYOUT

In meeting the expectation of 154kW of solar energy, is was immediately apparent that the rooftop of the Recreation Center was not sufficient to supply enough solar energy for the rec center and the pool. The square footage available on the roof can only support about 20% of the energy required for the facility. Thusly, we are showing option to produce all the power required for the pool facility by placing Carport Solar in the parking lot.

<u>Recreation Center</u>
144 Solar Panels
37,712 kWh Annually

<u>Parking Lot Canopy</u>
460 Solar Panels
135,309kWh Annually

Both of these options take advantage of underutilized, wasted space that had no environmental benefits. The solar carport also provides shade, which not only protects the vehicles from the harsh effects of the sun but minimizes radiant heat transfer, which will require more of the car's energy to cool down. This benefit is especially favorable when cars will be sitting for extended periods of time.

The following pages have examples of both of these systems.

PHOTO EXAMPLES – ROOFTOP SOLAR

PHOTO EXAMPLES – CARPORT SOLAR

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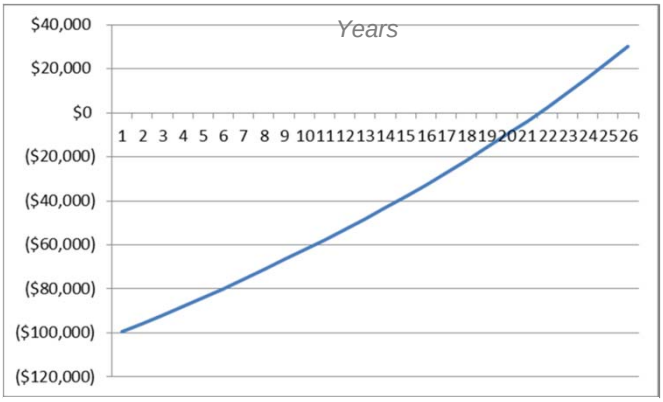
FINANCIAL ANALYSIS

Tax-exempt entities such as universities, charitable organizations, and municipalities have consistently been in the forefront of the environmental movement, leading the educational charge to understanding sustainability.
If these organizations consume energy from fossil fuels, they are benefiting from the millions in subsidies that utility companies are given. But if they generate their own renewable energy (which often aligns more with their missions), they are unfairly disenfranchised from receiving traditional subsidies, because they are tax-based.



Without the ability to monetize tax incentives, a typical Return on Investment (ROI) for solar energy would be approximately 21 years.

Tax Incentives account for approximately 50% of the Costs of Solar Energy. Power Purchase Agreements allow municipalities to monetize these tax incentives.

Through innovative deal structures municipalities can lease their roof or other property to a taxable entity (investor), who then installs a solar array. The investor then owns the solar system property, takes all the tax subsidies they may be entitled to, and sells the solar power at a discount to the municipality. After the investor has recouped his investment, they sell the solar array to the municipality at a far lower fair market value (FMV). These relationships are known as Power Purchase Agreements (PPAs)and are commonly used by municipal, city and state governments across the country.

This method gives the municipality the ability to monetize the tax incentives that they would not be eligible for otherwise. Since these incentives can add up to nearly 50% of the installed costs of solar, a PPA is an essential financial method in maintaining the fiduciary responsibility that municipalities are faced with when making capital improvements.

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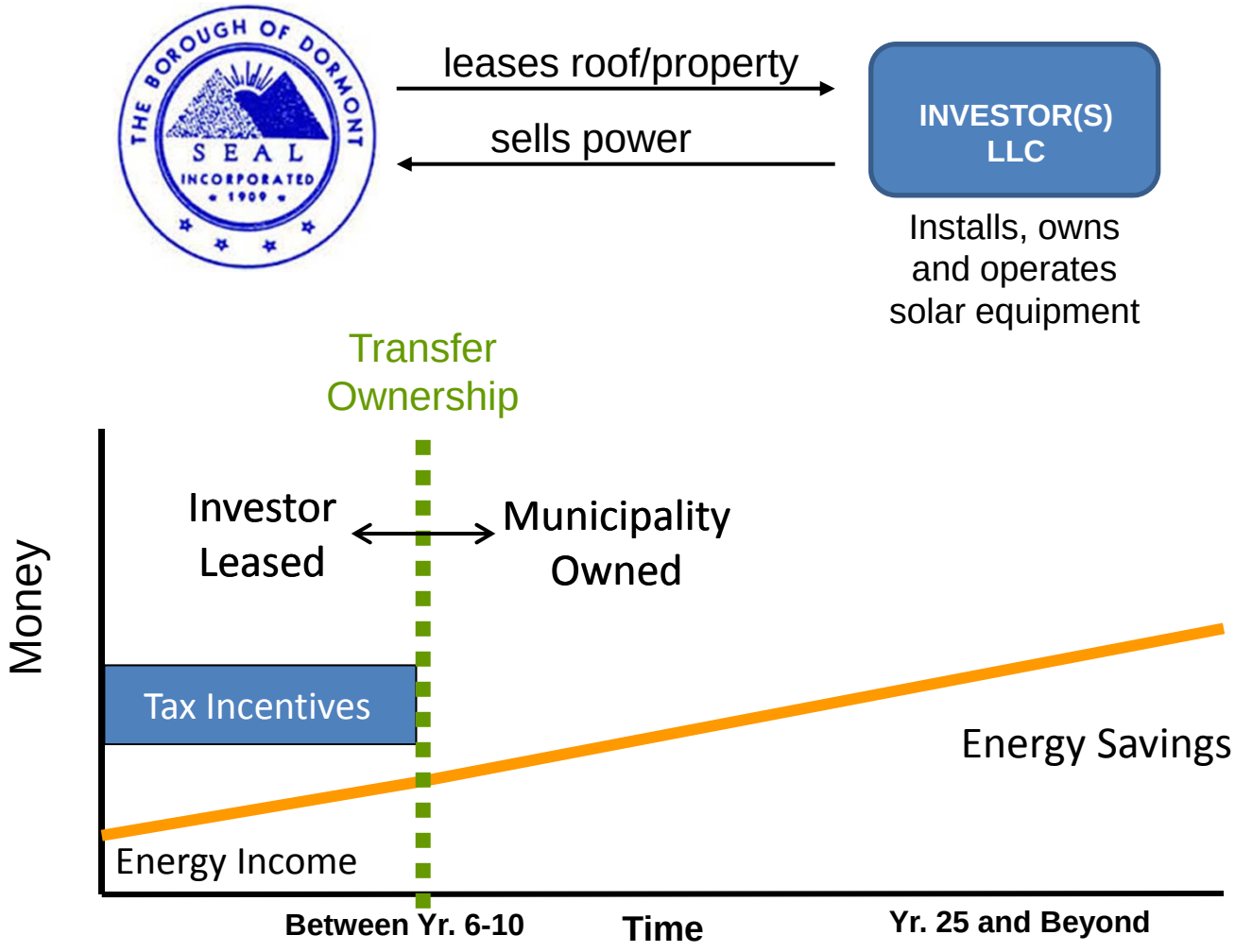
POWER PURCHASE AGREEMENTS



Financial Benefits to Municipality

- Pays lower and possibly fixed rate for electricity than currently paying.
- No Maintenance during investor ownership
- Additional Improvements made by Leasee become municipal property
- Able to monetize tax incentives and pay discounted price for solar equipment.

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BUDGET ESTIMATES

Recreation Center

Budget Estimate **$141,120**

Includes solar panels, mechanical support system, roof penetrations, electrical equipment, wiring, metering and installation.

as a PPA/Lease **$70,860**

Parking Lot Canopy

Budget Estimate **$491,320**

Includes solar panels, carport structures, electrical equipment, wiring, trenching, backfilling, metering and installation.

as a PPA/Lease **$245,660**

Combined Total of $316,520

Costs of Continuing to Purchase Fossil Fuels:

172,240 kWh x 8.4¢ = **$14,468** Each Year

Multiplied by 25 years with average utility increase of 3.7% = ***$559,152***

$559,152 - $316,520 = $242,632 Savings over Life of System.

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UTILITY INCREASES

This is a recent insert from local utility company: **Duquesne Light**

To Our Customers:
Duquesne Light Company ("Duquesne Light") is filing a request with the Pennsylvania Public Utility Commission (PUC) to increase your electric distribution service rates as of October 1, 2013. This notice describes the company's rate request, the PUC's role and what actions you can take. Duquesne Light has requested an overall rate increase of $76.3 million per year. If the company's entire request is approved, the total bill for an average residential customer using 600 kilowatt-hours would increase from $77.77 to $86.00 per month or by 10.58%. The total bill for an average commercial customer using 10,000 kilowatt-hours would increase from $853.07 to $900.39 per month or by 5.55%. The total bill for an average industrial customer using 200,000 kilowatt-hours would increase from $16,179.63 to $16,680.30 per month or by 3.09%. These proposed increases and percentages represent total Duquesne Light rates, which include rates for distribution, transmission and generation. These calculations are based upon current rates in effect as of July 1, 2013. To find out your customer class or how the requested increase may affect your electric bill, contact Duquesne Light at 1-888-393-7100. The rates requested by the company may be found in Supplement No. 81 to Tariff Number 24. You may examine the material filed with the PUC which explains the requested increase and the reasons for it. A copy of this material is kept at Duquesne Light's office at 411 Seventh Avenue, Pittsburgh, PA 15219. Upon request, the company will send you the Statement of Reasons for Supplement No. 81 to Tariff Number 24, explaining why the rate increase has been requested.

https://www.duquesnelight.com/DLDocs/shared/manageMyAccount/billingOptions/noticeOfProposedRateChanges.pdf

See the actual notice on the utilities website

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ANALYSIS SUMMARY

The purpose of this analysis was to provide the Borough of Dormont the means for understanding and evaluating the possibility of employing solar energy on its facility at the Recreation Center.

Many aspects of solar integration must be considered before making a decision to utilize renewable energy. First of which is access to the sun. A solar shade evaluation on the roof concluded that the site has 96% clear access to the sun.

Solar panels will produce power well past 25 years; It would be ill-advised to place them on a roof that is in need of replacement. The roof at the Rec. Center is beyond its serviceable life, and will need replaced in 1-2 years. A simple assessment of the buildings electrical system shows it to be functional yet outdated. A small solar array would not require updating these systems, but a large array would necessitate upgrading the service entrance equipment.

Due to the heavy electricity usage to run the pool, the rooftop alone is not big enough to provide an equal amount in solar energy.(approx. 20%) An alternative location of the parking lot was shown using carport solar which would also shade the vehicles during hot summer months. The amount of solar necessary would be 154kW.

Because municipalities cannot take advantage of tax credits associated with solar energy, they would pay 50% more than other commercial users. Power Purchase Agreements (PPA/Lease) allow municipalities to monetize the tax incentives, and make solar affordable. Any added improvements to the facility by the leasee (roof replacement or electrical upgrade) will become property of the municipality at the end of the lease. A cost analysis of this model shows that the Borough could save as much as $242,642 over the life of the system.

The environmental benefits of using solar energy at the Pool & Rec Center would help offset some of the 122 metric tons of CO_2 from their carbon footprint. The visibility to patrons, members of the community and passersby would also be significant from an educational standpoint.

DISCLAIMERS

No guarantee or warranty of any information provided, facility inspected, or assertion made is included or implied in this evaluation. This analysis is for informational purposes only.

Scalo Solar does not claim or warrant or the existence or absence of any particular electrical hazard in this analysis. Only the suitability of integrating solar into the existing equipment. Existing deficiencies may or may not be present and are not included in this analysis.

IRS Circular 230 Notice Requirement: This analysis is not given in the form of a covered opinion, within the meaning of Circular 230 issued by the U.S. Secretary of the Treasury. Thus, you cannot rely upon any tax advice contained herein for the purpose of avoiding U.S. federal tax penalties. In addition, any tax advice contained herein may not be used to promote, market or recommend a transaction to another party.
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Appendix

Roof Inspection Report
Roof Life Cycle Savings Report

Management Report

Borough of Dormont
Dormont Pool House
Dormont Avenue, Dormont, PA

Prepared For
Borough of Dormont

Powered By

Burns & Scalo PA Commercial
22 Rutgers Rd # 200
Pittsburgh PA 15205-2565
P: 412-928-3060 F: 412-928-8705
www.burns-scalo.com/roofing
License: PA1640

Borough of Dormont

Dormont Pool House
Dormont Avenue
Dormont, PA

Site Overview

Total Sections: 1
Total Sq/Ft: 4,641

Map	Name	Sq/Ft	Est Install	Grade
1	Main Roof	4,641	1983	F

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Borough of Dormont

Dormont Pool House
Dormont Avenue
Dormont, PA

Composition

Section: Main Roof
Size: 4,641
Overall Grade: F

Inspection Date: 10/22/2013
Inspector: Rich DeThomas

Core
Wood
Rosen Paper
2.5" Perlite Insulation
1/2" BUR
1/2" Fiberboard Insulation
.045 EPDM

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Borough of Dormont

Dormont Pool House
Dormont Avenue
Dormont, PA

Observations

Section: Main Roof
Size: 4,641
Overall Grade: F

Inspection Date: 10/22/2013
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North Overview

West Overview

South Overview

East Overview

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Borough of Dormont

Dormont Pool House
Dormont Avenue
Dormont, PA

Deficiencies

Section: Main Roof
Size: 4,641
Overall Grade: F

Inspection Date: 10/22/2013
Inspector: Rich DeThomas

General - Loose Debris (Remedial)
Quantity: 50 SF
Deficiency:
Loose debris has a high probability of blowing around on the roof and causing damage to the waterproofing membrane.
Corrective Action:
Remove loose debris from roof area.
Estimated Repair Cost:
$300.00

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Borough of Dormont

Dormont Pool House
Dormont Avenue
Dormont, PA

Deficiencies (continued)

Section: Main Roof
Size: 4,641
Overall Grade: F

Inspection Date: 10/22/2013
Inspector: Rich DeThomas

General - Previous Repair Failure (Emergency)
Quantity: 1 EA
Deficiency:
Existing repair failing due to age or improper repair.
Corrective Action:
We will remove the existing repair, clean and prime area, and install new patch to ensure water tightness.
Estimated Repair Cost:
$325.00

General - Open Seams (Emergency)
Quantity: 100 LF
Deficiency:
Open seams in the waterproofing membrane are typically caused by failing seam adhesives coupled with membrane shrinkage and stress on the seams.
Corrective Action:
The area surrounding the open seam must be cleaned. A new piece of waterproofing membrane would be installed and sealed per industry standards.
Estimated Repair Cost:
$1,250.00

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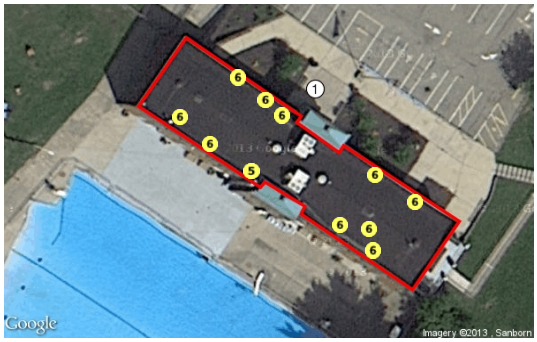
Borough of Dormont

Dormont Pool House
Dormont Avenue
Dormont, PA

Deficiencies (continued)

Section: Main Roof
Size: 4,641
Overall Grade: F

Inspection Date: 10/22/2013
Inspector: Rich DeThomas



General - Physical Damage (Emergency)
Quantity: 1 EA
Deficiency:
Fasteners are no longer securing the roofing system in place
Corrective Action:
Replace the loose fasteners and overlay the open holes
Estimated Repair Cost:
$275.00

General - Bridging (Emergency)
Quantity: 1000 SF
Deficiency:
Tenting of the membrane is caused by the overall shrinking that takes place over time. The shrinking of the membrane causes it to pull away from perimeter walls and creates stress of the flashing areas of the roof. This and the membrane has become no longer adhered to the insulation.
Corrective Action:
The existing membrane would need to be cut and allowed to relax and a new piece of flashing membrane spliced in to ensure a water tight seal. Due to the amount of loose membrane, large sections of this roof will also need to be opened up and readhered.
Estimated Repair Cost:
$22,500.00

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Borough of Dormont

Dormont Pool House
Dormont Avenue
Dormont, PA

Deficiencies (continued)

Section: Main Roof
Size: 4,641
Overall Grade: F

Inspection Date: 10/22/2013
Inspector: Rich DeThomas

7

General - Physical Damage (Emergency)
Quantity: 1 EA
Deficiency:
Damage to any roof system or drainage system that is caused by storms, negligence, or remodeling, etc. that is not consistent with normal weather or age-related conditions.
Corrective Action:
Repair or replace any damaged membrane or materials needed to restore the roof system or drainage system back to original condition.
Estimated Repair Cost:
$225.00

8

General - Failing Penetration (Commercial) (Remedial)
Quantity: 8 EA
Deficiency:
Due to overall age, weathering, and UV, the penetration has failed.
Corrective Action:
The penetration should be repaired/flashed per industry standards to ensure a water tight seal.
Estimated Repair Cost:
$650.00

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Borough of Dormont

Dormont Pool House
Dormont Avenue
Dormont, PA

Deficiencies (continued)

Section: Main Roof
Size: 4,641
Overall Grade: F

Inspection Date: 10/22/2013
Inspector: Rich DeThomas

9

General - Physical Damage (Emergency)
Quantity: 2 EA
Deficiency:
Damage to any roof system or drainage system that is caused by storms, negligence, or remodeling, etc. that is not consistent with normal weather or age-related conditions. The securement of the wire bracket has pulled out of the metal.
Corrective Action:
Re secure the bracket for the wires
Estimated Repair Cost:
$450.00

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Borough of Dormont

Dormont Pool House
Dormont Avenue
Dormont, PA

Summary

Section: Main Roof
Size: 4,641
Overall Grade: F

Inspection Date: 10/22/2013
Inspector: Rich DeThomas

Condition Summary

Membrane:	D
Flashings:	F
Sheet Metal:	D
Overall:	F

Overall Grade
A = 10 Years or more of service life remaining
B = 8-10 Years of service life remaining
C = 5-7 Years of service life remaining
D = 2-4 Years of service life remaining
F = Less than 1 Year of service life remaining

Estimated Replacement: 2014

Recommendations
Due to the age and existing deterioration of this roofing system, our recommendation is the total replacement of this roofing system.
Estimated Repair Costs: $25,975.00

Estimated Replacement Costs: $55,691.16

Burns & Scalo PA Commercial
22 Rutgers Rd # 200
Pittsburgh PA 15205-2565
P: 412-928-3060 F: 412-928-8705
www.burns-scalo.com/roofing
License: PA1640

Borough of Dormont

Dormont Pool House
Dormont Avenue
Dormont, PA

Summary

Section: Main Roof
Size: 4,641
Overall Grade: F

Inspection Date: 10/22/2013
Inspector: Rich DeThomas

1 - Main Roof (4,641 SF) Grade F

Deficiency	Qty	Emergency	Remedial	Replacement
			$0.00	
Loose Debris	50 SF		$300.00	
Previous Repair Failure	1 EA	$325.00		
Open Seams	100 LF	$1,250.00		
Physical Damage	1 EA	$275.00		
Bridging	1000 SF	$22,500.00		
Physical Damage	1 EA	$225.00		
Failing Penetration (Commercial)	8 EA		$650.00	
Physical Damage	2 EA	$450.00		
Full Replacement	4,641 SF			$55,691.16
Total		$25,025.00	$950.00	$55,691.16

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Borough of Dormont

Dormont Pool House
Dormont Avenue
Dormont, PA

Budget Matrix
Dormont Pool House
Dormont, PA
4,641 Sq/Ft

Overall Grade
A = 10 Years or more of service life remaining
B = 8-10 Years of service life remaining
C = 5-7 Years of service life remaining
D = 2-4 Years of service life remaining
F = Less than 1 Year of service life remaining

		Emergency	Remedial	Replacement
1 - Main Roof (4,641 SF) Grade F				
Projected Replacement: 2014				
Deficiency	**Qty**			
			$0.00	
Loose Debris	50 SF		$300.00	
Previous Repair Failure	1 EA	$325.00		
Open Seams	100 LF	$1,250.00		
Physical Damage	1 EA	$275.00		
Bridging	1000 SF	$22,500.00		
Physical Damage	1 EA	$225.00		
Failing Penetration (Commercial)	8 EA		$650.00	
Physical Damage	2 EA	$450.00		
Full Replacement	4,641 SF			$55,691.16
Total		$25,025.00	$950.00	$55,691.16

	Emergency	Remedial	Replacement
Budget Totals	**$25,025.00**	**$950.00**	**$55,691.16**

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RoofSense Life Cycle Savings Report

Project: Dormont Recreation Center
Scenario: Exisitng vs. R-20
Prepared By: Carnahan, Mike,
Date: 10/30/2013 11:42:55 AM

Roof Project Summary

Customer Data

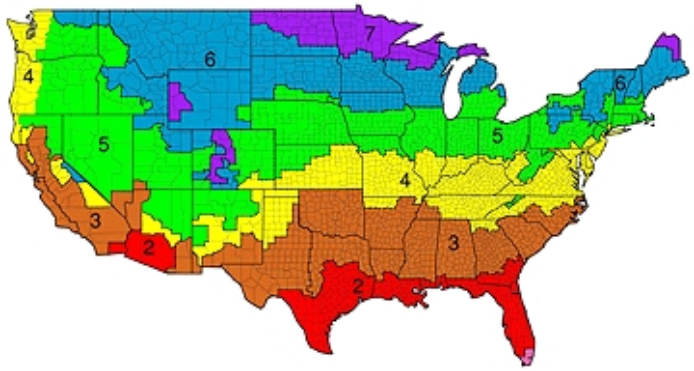
Customer: , Dormont Borough
Address:
Pittsburgh, PA 15219
Phone:

Project Information

Location: Dormont Avenue, PITTSBURGH, PA
Term of Analysis: 20 Years
Roof Area: 4,641 sq. ft.
Facility Type: Government

Regional Weather Summary

ASHRAE Station: Pittsburgh
Heating Degree Days: 5950
Cooling Degree Days: 645



RoofSense Weather Data

Regional weather data, Heating Degree Days (HDD) and Cooling Degree Days (CDD) are based on 30 year historical data from National Oceanic and Atmospheric Administration (NOAA).
http://cdo.ncdc.noaa.gov/CDO/cdo

The map shown here shows ASHRAE U.S. Climate Zones, for the United States. Climate Zones are based on ASHRAE standard 90.1-2004 with zone 1 being the hottest zone and zone 8 being the coldest zone.

ASHRAE Alert

Minimum Insulation Levels:
The 2007 version of the ASHRAE 90.1 standard contained updated R-values for commercial roofs. This new updated value mandates a 33% increase from the 2004 ASHRAE Standard 90.1 in climate zones 2 through 7.

Many regulatory agencies will be adopting this increase as the minimum standard for all new construction design projects. Most buildings will be required to upgrade the levels of insulation used in their proposed roof systems during new construction or re-roofing operations where insulation is being removed to comply with the new ASHRAE minimum standards.

In light of the ASHRAE increases, the Polyisocyanurate Insulation Manufacturers Association (PIMA) has taken the initiative of publishing recommended R-values categorized by ASHRAE zones for use to reach beyond the new ASHRAE minimum standards.

RoofSense Life Cycle Savings Report

Project: Dormont Recreation Center
Scenario: Exisitng vs. R-20
Prepared By: Carnahan, Mike,
Date: 10/30/2013 11:42:55 AM

Roof Details

Roof Assembly
The following items were included in the roof assembly structure as a part of the life cycle cost comparison. The R values are shown for each included component of the assembly. Components in the assembly are present in the baseline roof as well as the proposed roof.

Assembly Item	R Value
Outside Air	0.17
Membrane	0.33
Cover Board	0.5
Roof Insulation	6.75
Vapor Retarder	0.12
Base Board	0
Deck	1.25
Air Space	0.94
Batt Insulation	0
Ceiling Tile	0
Inside Air	0.61
Total Assembly R:	10.67

What is R-Value?

R-Value is a measure of apparent thermal conductivity, and thus describes the rate that heat energy is transferred through a material or assembly item, regardless of the heat source.

Higher R Value indicates a higher resistance to heat transfer. R values provided are from manufacturer specification or provided as scientific constants unless otherwise noted.

Roof Membrane and Insulation:
The following section details the roof membrane and insulation for the baseline and proposed roof systems being observed in the life cycle cost comparison.

Baseline Roof A:	Proposed Roof B:
Existing Roof	**R-20 TPO**
Roof Surface Type:	Roof Surface Type:
Sure-Seal	TPO White
Existing Assembly Insulation R: 6.75	Existing Assembly Insulation R: 6.75
Insulation R to be Added: 0	Insulation R to be Added: 18.2
Layer 1: n/a	Layer 1: 1.5 inches of Polyiso
Layer 2: n/a	Layer 2: 1.5 inches of Polyiso
Total Insulation R: 6.75	Total Insulation R: 24.95

RoofSense Life Cycle Savings Report

Project: Dormont Recreation Center
Scenario: Exisitng vs. R-20
Prepared By: Carnahan, Mike,
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Energy Cost Summary

Heating and Cooling Data:
The heating and cooling load is referred to as the cost to heat and cool the facility. Following are the details of the buildings system efficiency, fuel type and associated cost used in the energy load calculation.

Cooling Data	Heating Data
Fuel Type: Electricity	Fuel Type: Natural Gas
System Efficiency: 10 S.E.E.R or E.E.R	System Efficiency: 75%
Fuel Cost: $0.084 /Kwh	Fuel Cost: $5.04 /1000 CF
Fuel Inflation Rate: 3.7% per yr	Fuel Inflation Rate: 2.4% per yr

Estimated Energy Cost:
The energy model within RoofSense compares the estimated energy cost of two roof systems over the term of analysis. Fuel cost and inflation, interior temperature, climate, roof surface type and color, and the amount of insulation utilized are included in the energy cost formulas. The following are estimated energy costs.

A Existing Roof

Estimated Energy Cost:

Cooling: $4,244.43
Heating: $10,799.06

Total: $15,043.49

Environmental Emissions:

CO2 Carbon Dioxide	334.85 Tons
CH4 Methane	5.69 LBS
NOx Nitrogen Oxides	10.79 LBS

B R-20 TPO

Estimated Energy Cost:

Cooling: $919.52
Heating: $3,951.29

Total: $4,870.81

Environmental Emissions:

CO2 Carbon Dioxide	119.23 Tons
CH4 Methane	2.02 LBS
NOx Nitrogen Oxides	3.84 LBS

Energy Cost Savings

$10,172.68 less dollars — 67.62%

Carbon Reduction:

215.6 less tons — 64.39%

Savings is equivalent to:

- **862** Trees planted
- **329998** Airplane miles
- **43** Less cars on road

Energy Savings Notes:
The RoofSense energy savings model is based on the LC4 Life Cycle cost analysis tool developed by Pat Downey of Merik Professional Roofing Services in the late 1990's. The LC4 energy calculations and formulas are taken from the "1989 ASHRAE Fundamentals Handbook". Also used was the "Guide for Estimating Difference in Building Heating and Cooling Energy due to Change in Solar Reflectance of a Low-Slopped Roof", Oak Ridge National Laboratory publication ORNL-6527 and the "NRCA Energy Manual" third edition, National Roofing Contractors Association, Chicago, IL. Adjustments to the formula and reflectance have been made as a result of a benchmarking study completed using Carrier's "Hourly Analysis Program" (HAP) and ASHRAE's standards on building simulation. Carrier's HAP is approved by the government for studies done for the Tax Policy Act of 2005. Historic energy cost data, when used, has been obtained from the Energy Information Agency (EIA) www.eia.doe.gov.