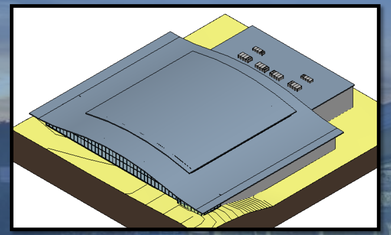
The Mirenda Center for Sport Spirituality and Character Development

Zachary Heilman
Mechanical Option | 2011
Dr. Jim Freihaut | Dustin Eplee

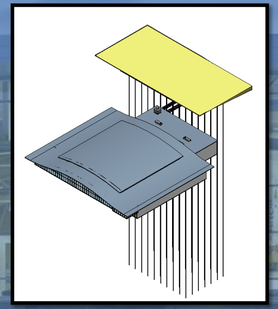
The Mirenda Center for Sport Spirituality and Character Development



$96,000

38 kBtu/ sf yr

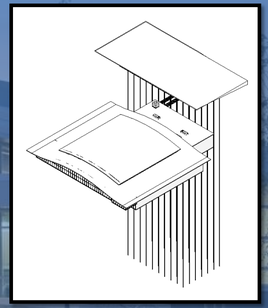
Existing



$61,000

18 kBtu/ sf yr

Proposed

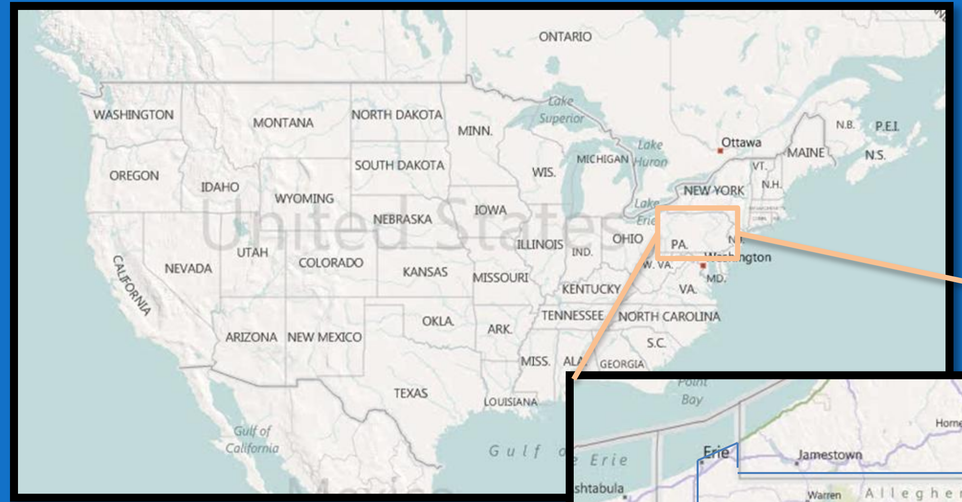


$35,000

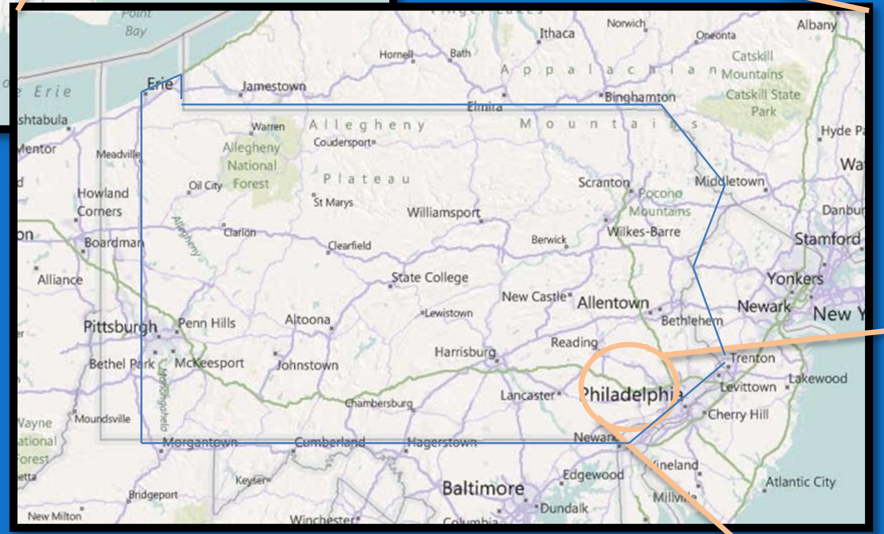
20 kBtu/ sf yr

Savings

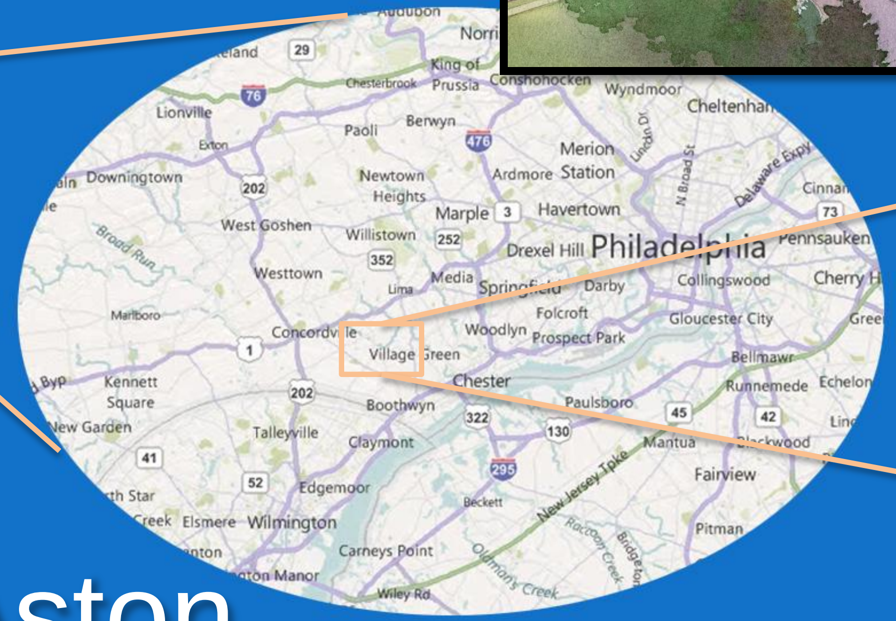
Introduction
Building Function
Existing Mechanical System
Ground Coupled Heat Pump
Cost Analysis
Mezzanine Proposal
Conclusion



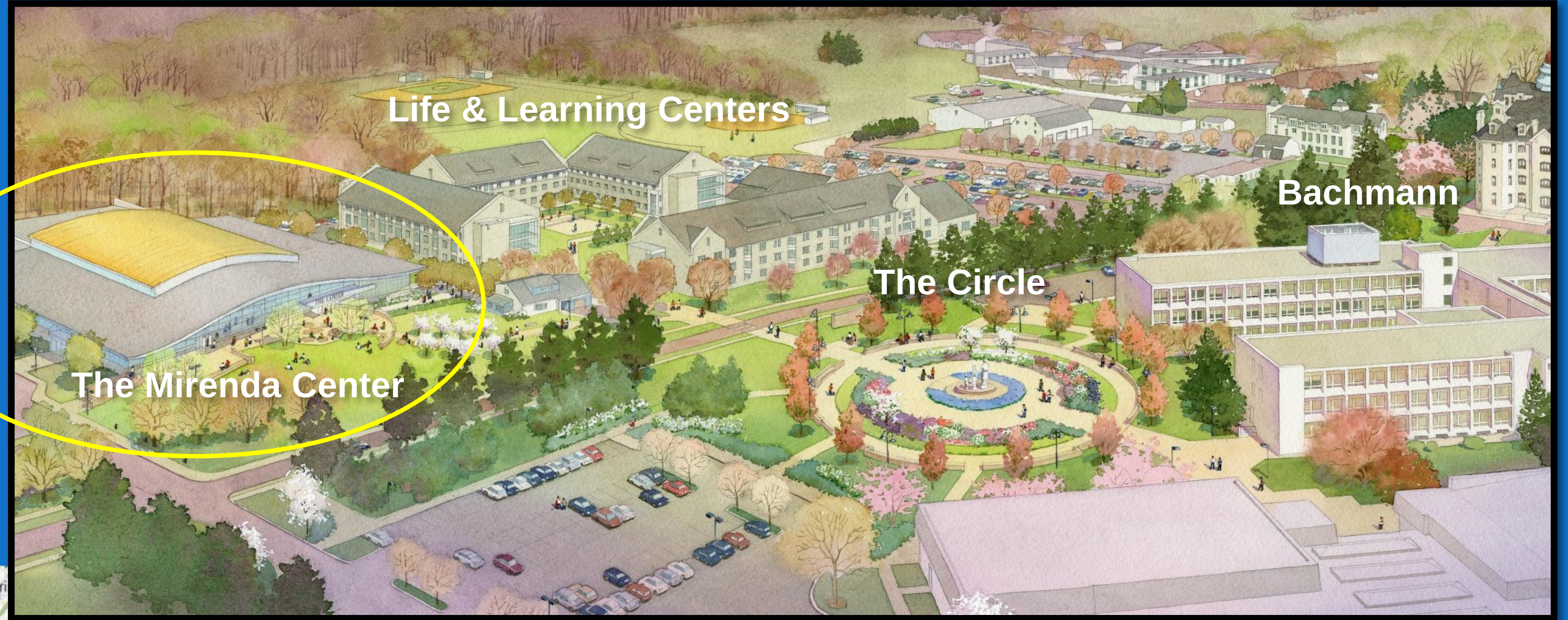
U.S.A.

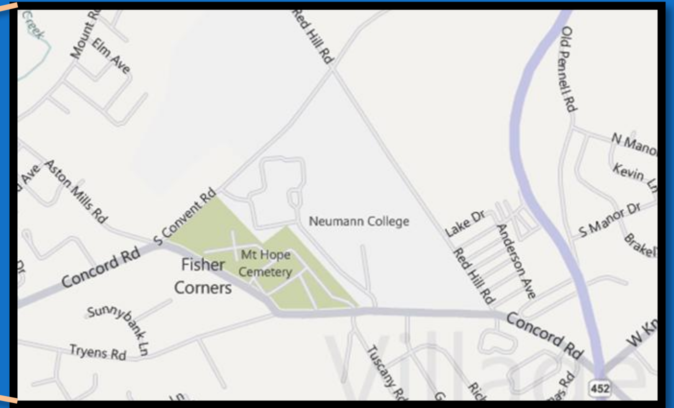


Pennsylvania

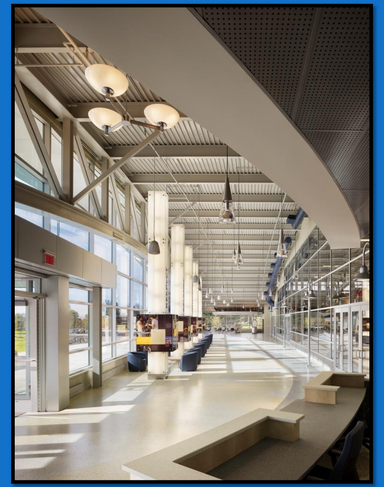


Aston

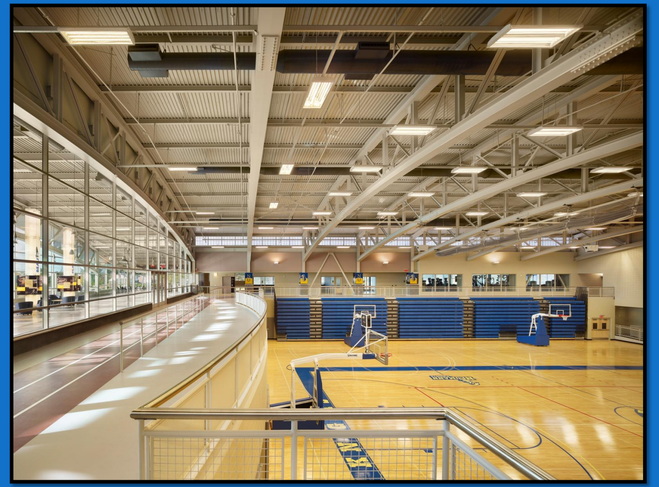




Neumann University



Welcoming Center



Running Track & Main Gymnasium

Fitness Center

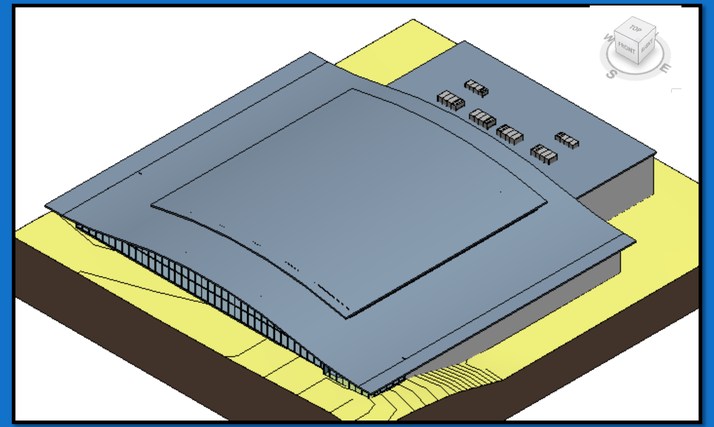
6 Packaged Roof Top Units

zachary heilman
architectural engineering mechanical
Presents

THE MIRENDA CENTER

For Sport, Spirituality, and Character Developement

One Neumann Drive Aston PA 19014-4707



Direct Expansion Cooling

Natural Gas Heating

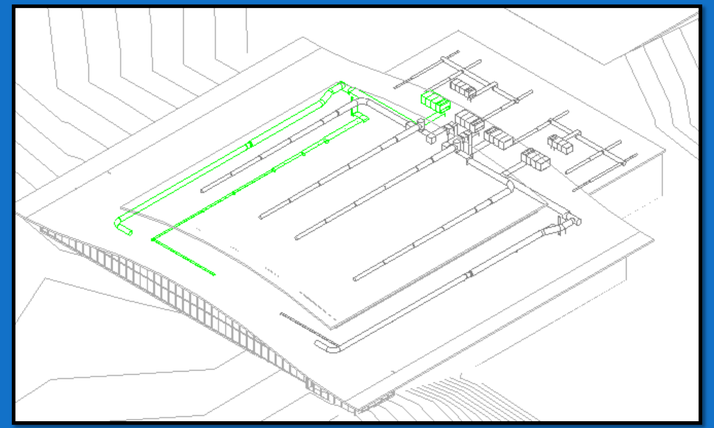
Roof Top Unit (1)

zachary heilman
architectural engineering mechanical
Presents

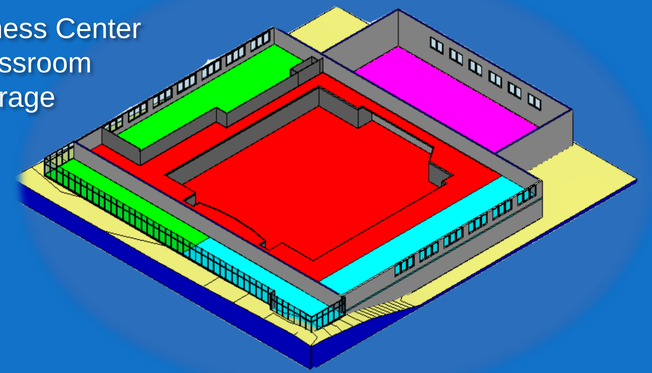
THE MIRENDA CENTER

For Sport, Spirituality, and Character Developement

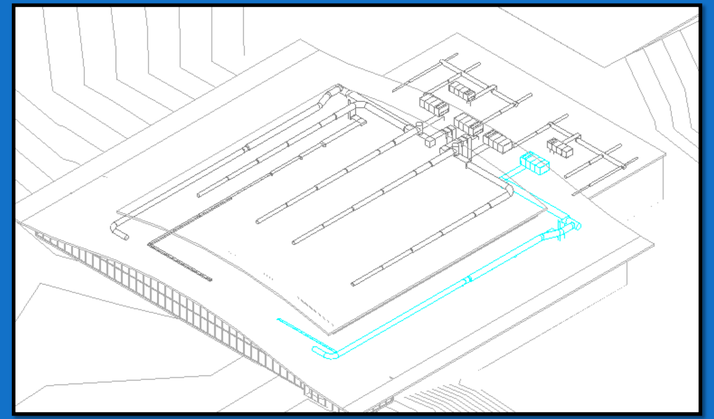
One Neumann Drive Aston PA 19014-4707



Fitness Center
Classroom
Storage



Roof Top Unit (2)



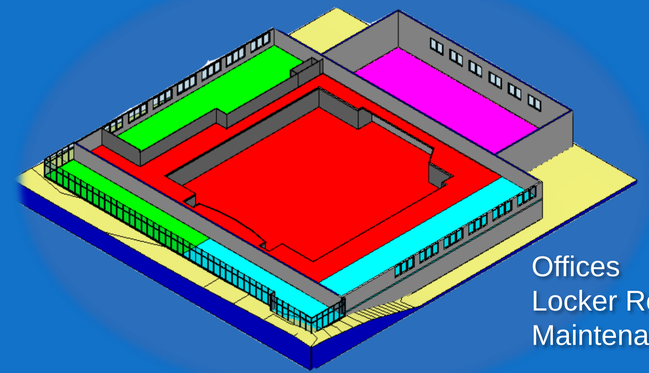
zachary heilman
architectural engineering mechanical

Presents

THE MIRENDA CENTER

For Sport, Spirituality, and Character Developement

One Neumann Drive Aston PA 19014-4707



Offices
Locker Room
Maintenance

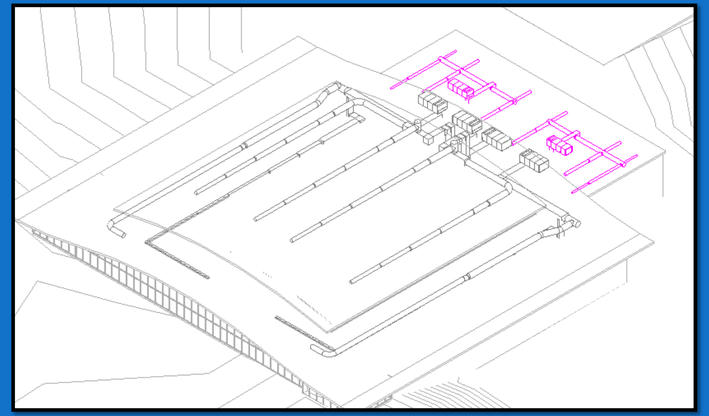
Roof Top Unit (**3 & 4**)

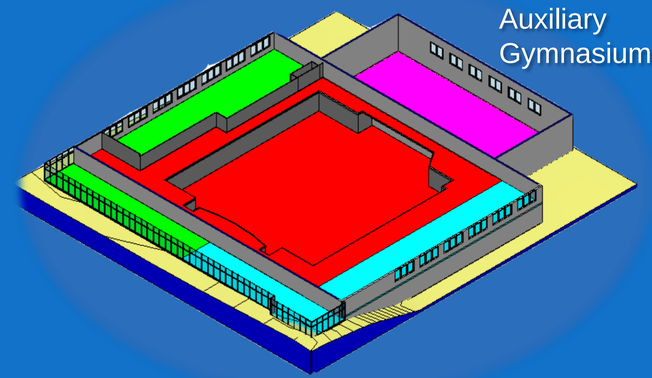
zachary heilman
architectural engineering mechanical
Presents

THE MIRENDA CENTER

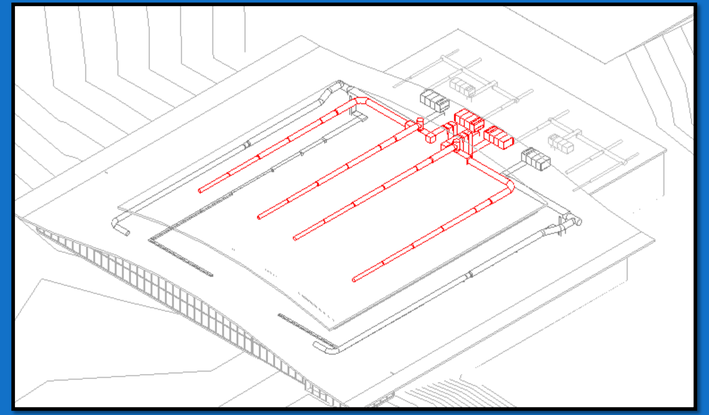
For Sport, Spirituality, and Character Developement

One Neumann Drive Aston PA 19014-4707





Roof Top Unit (**5 & 6**)



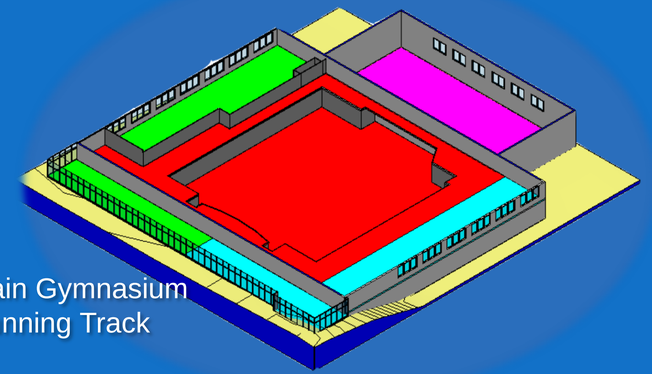
zachary heilman
architectural engineering mechanical

Presents

THE MIRENDA CENTER

For Sport, Spirituality, and Character Developement

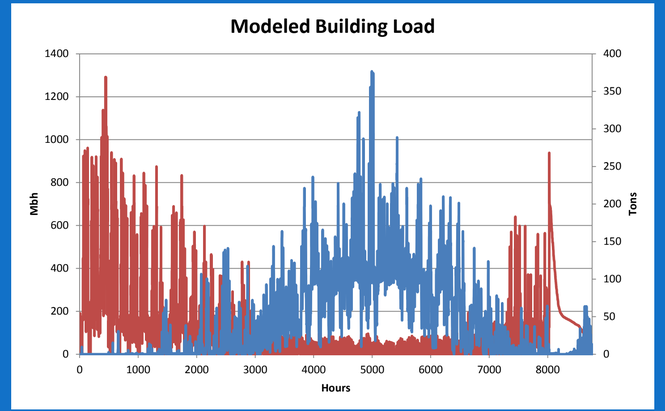
One Neumann Drive Aston PA 19014-4707



Main Gymnasium
Running Track

- Introduction
- Building Function
- Existing Mechanical System
- Ground Coupled Heat Pump
- Cost Analysis
- Mezzanine Proposal
- Conclusion

Trane Trace Energy Model

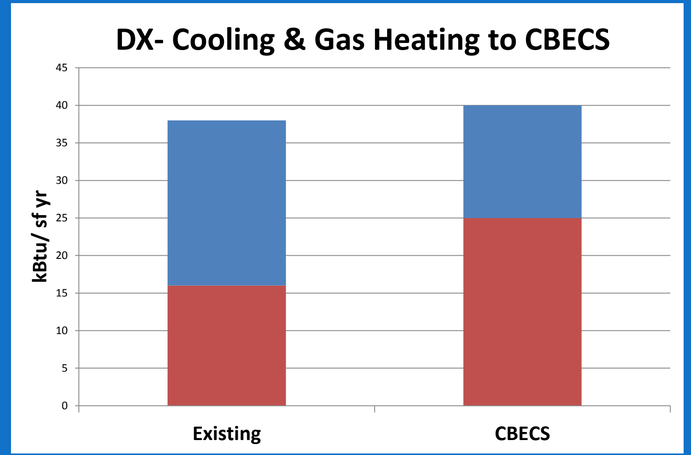


zachary heilman
architectural engineering mechanical
Presents
THE MIRENDA CENTER
For Sport, Spirituality, and Character Developement
One Neumann Drive Aston PA 19014-4707

Trace Input:

Internal Loads	- people, lighting
Ventilation Loads	- 20% minimum
Tmy Weather Data	- Philadelphia
Building Materials	- walls, roof, slab
Schedule of Use	- wkday, wkend, summer, winter

- Introduction
- Building Function
- Existing Mechanical System
- Ground Coupled Heat Pump
- Cost Analysis
- Mezzanine Proposal
- Conclusion



** note CBECS is Commercial Buildings Energy Consumption Survey*

zachary heilman
architectural engineering mechanical
Presents
THE MIRENDA CENTER
For Sport, Spirituality, and Character Developement
One Neumann Drive Aston PA 19014-4707

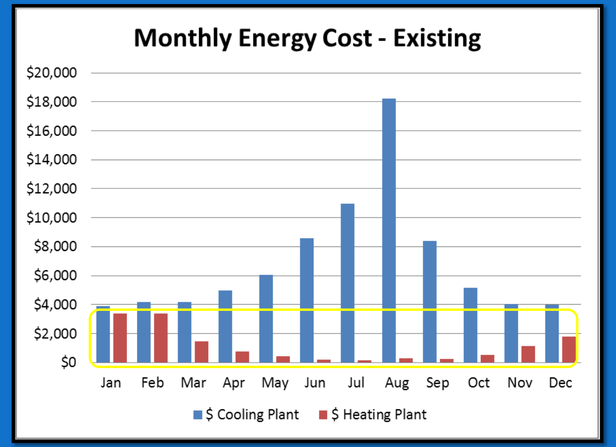
Natural Gas Heating
0.85

Heating= 16 kBtu/ sf yr

Direct Expansion Cooling
COP=2.8

Cooling= 22 kBtu/ sf yr

Monthly Energy Cost - Existing



zachary heilman
architectural engineering mechanical
Presents

THE MIRENDA CENTER

For Sport, Spirituality, and Character Developement

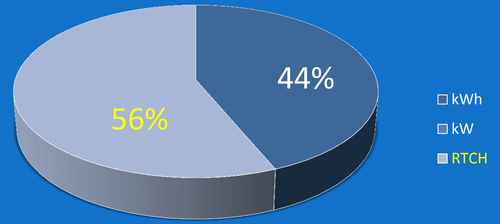
One Neumann Drive Aston PA 19014-4707

Building Statistics

N. Gas	=$0.05/ ccf (1000 btu/ c.f.
Consumption	=$0.06 / kwh
Demand (Dmd)	=$6.21 / kw
Ratchet	= Dmd* 12 MONTHS
$ Heating	= $13,731
$ Cooling	= $82,735
$ Totals	= $96,466

- Introduction
- Building Function
- Existing Mechanical System
- Ground Coupled Heat Pump
- Cost Analysis
- Mezzanine Proposal
- Conclusion

Utility Rate Structure - Existing



Cost Breakdown of Electricity

zachary heilman
architectural engineering mechanical
Presents
THE MIRENDA CENTER
For Sport, Spirituality, and Character Developement
One Neumann Drive Aston PA 19014-4707

Building Statistics

N. Gas	=$0.05/ ccf (1000 btu/ c.f.
Consumption	=$0.06 / kwh
Demand (Dmd)	=$6.21 / kw
Ratchet	= Dmd* 12 MONTHS
$ Heating	= $13,731
$ Cooling	= $82,735
$ Totals	= $96,466

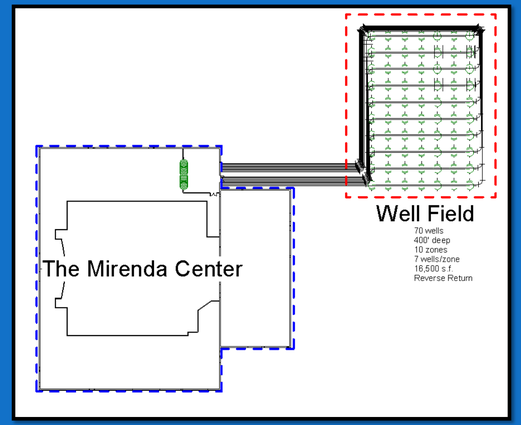
Ground Coupled Heat Pump

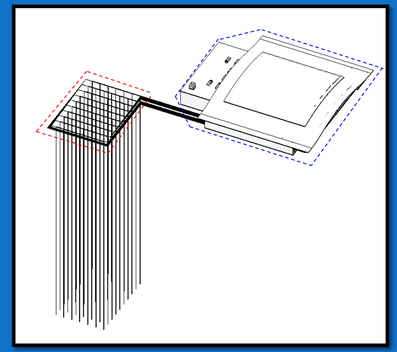
zachary heilman
architectural engineering mechanical
Presents

THE MIRENDA CENTER

For Sport, Spirituality, and Character Developement

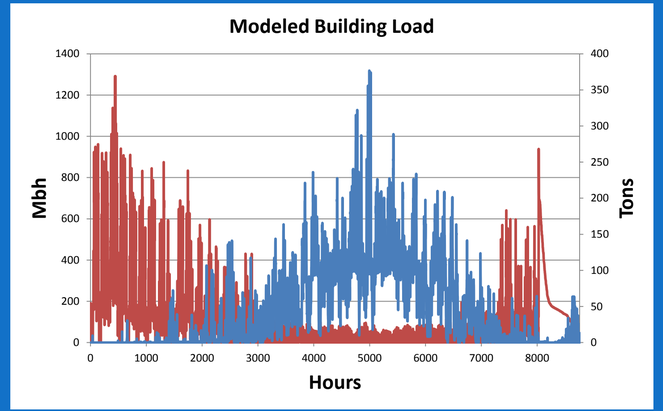
One Neumann Drive Aston PA 19014-4707





Ground Coupled HP System

- Introduction
- Building Function
- Existing Mechanical System
- Ground Coupled Heat Pump
- Cost Analysis
- Mezzanine Proposal
- Conclusion



zachary heilman
architectural engineering mechanical
Presents

THE MIRENDA CENTER

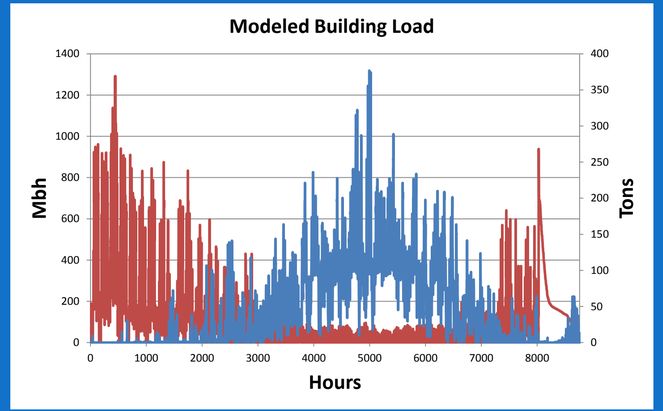
For Sport, Spirituality, and Character Developement

One Neumann Drive Aston PA 19014-4707

Rule of Thumb

Well Sizing	=	150 ft/ ton
Cooling	=	460 tons
Heating	=	1291 Mbh
Depth of Well	=	400 ft
Wells Cooling	=	172 wells

Ground Coupled HP System



zachary heilman
architectural engineering mechanical

Presents

THE MIRENDA CENTER

For Sport, Spirituality, and Character Developement

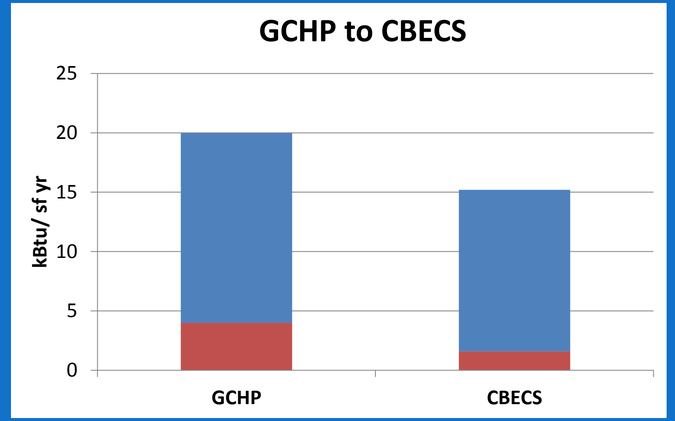
One Neumann Drive Aston PA 19014-4707

ASHRAE Calculation

Well Size	=	171 ft/ton
Cooling	=	460 tons
Heating	=	1291 Mbh
Depth of Well	=	400 ft
Wells Cooling	=	199 wells
Wells Heating	=	42 wells

- Introduction
- Building Function
- Existing Mechanical System
- Ground Coupled Heat Pump
- Cost Analysis
- Mezzanine Proposal
- Conclusion

Total Energy Comparison



zachary heilman
architectural engineering mechanical
Presents

THE MIRENDA CENTER

For Sport, Spirituality, and Character Developement

One Neumann Drive Aston PA 19014-4707

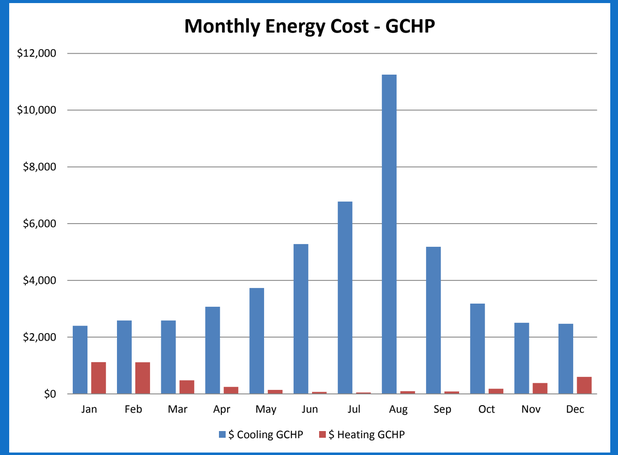
Heat Pump Calculation

COP = 4.5

Heating = 4 kBtu/ sf yr
Cooling = 14 kBtu/ sf yr

20-40 ft ceiling height

Ground Coupled HP System



zachary heilman
architectural engineering mechanical
Presents

THE MIRENDA CENTER

For Sport, Spirituality, and Character Developement

One Neumann Drive Aston PA 19014-4707

Building Statistics

$ Heating	= $4,274
$ Cooling	= $51,026
$ Total	= $55,298

Savings = $41,168

Conventional DX Gas	= $1.33/s.f.
GCHP	= $0.76/s.f.

Cost Analysis

zachary heilman
architectural engineering mechanical
Presents
THE MIRENDA CENTER
For Sport, Spirituality, and Character Developement
One Neumann Drive Aston PA 19014-4707

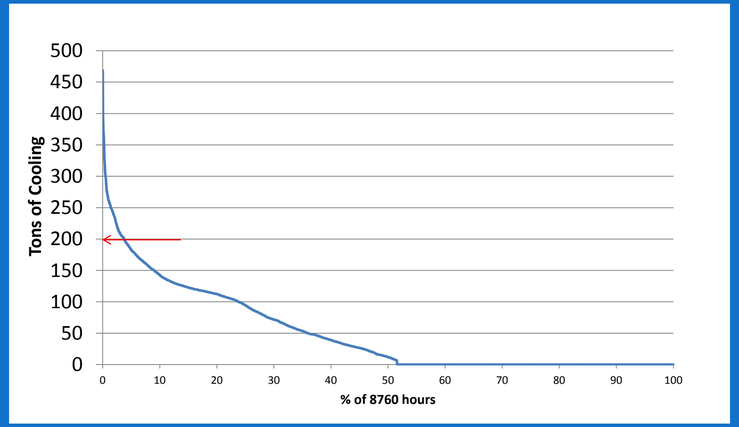
Cost of (6) RTU	$476,269	
Unit Well Cost (Grout + Pipe + Drilling)	$8,104	$1,612,767
Distribution Piping Zone (2) Pipes per Zone	$1,990	$33,007
Pumps + Elbows + Tees + Valves per zone	$650	$10,779
Number of Wells	199	
Number of Zones	12	
Total Cost		$2,132,822
Cost of GCHP Wells		$1,656,553
Payback the Cost of Wells		40

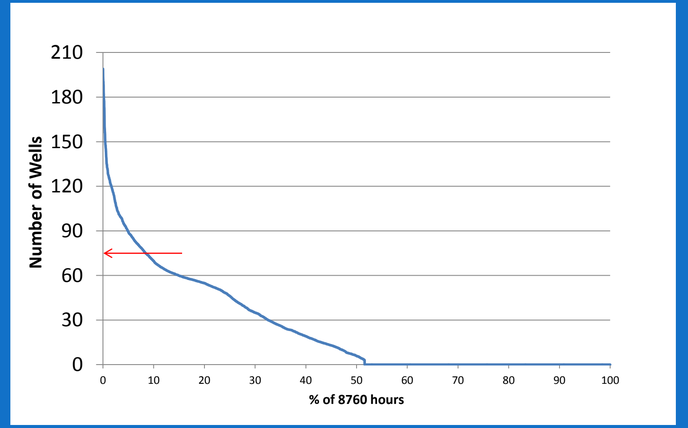
Cost Analysis

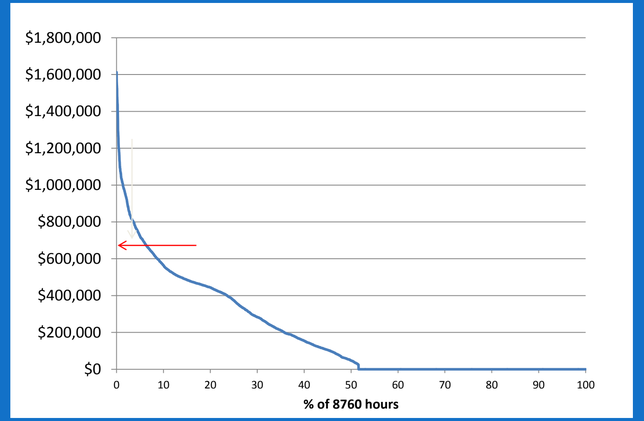
zachary heilman
architectural engineering mechanical
Presents
THE MIRENDA CENTER
For Sport, Spirituality, and Character Developement
One Neumann Drive Aston PA 19014-4707

Cost of (6) RTU	$476,269	
Unit Well Cost (Grout + Pipe + Drilling)	$8,104	$1,612,767
Distribution Piping Zone (2) Pipes per Zone	$1,990	$33,007
Pumps + Elbows + Tees + Valves per zone	$650	$10,779
Number of Wells	199	
Number of Zones	12	
Total Cost		$2,132,822
Cost of GCHP Wells		$1,656,553
Payback the Cost of Wells		40

Hybrid GCHP with Cooling Tower

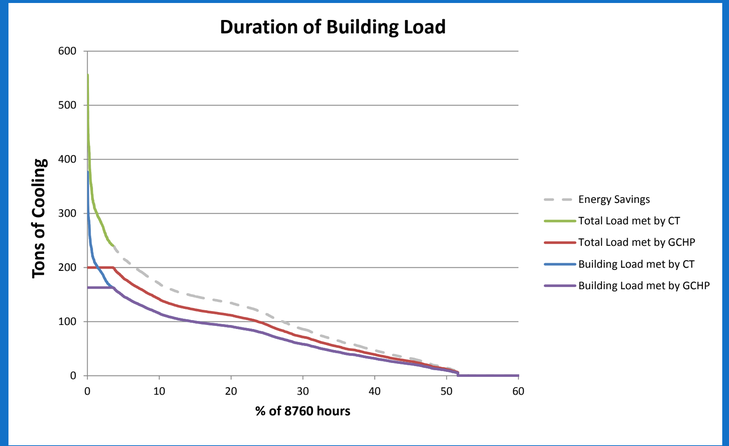






Hybrid GCHP with Cooling Tower

- Introduction
- Building Function
- Existing Mechanical System
- Ground Coupled Heat Pump
- Cost Analysis
- Mezzanine Proposal
- Conclusion



zachary heilman
architectural engineering mechanical
Presents

THE MIRENDA CENTER

For Sport, Spirituality, and Character Developement

One Neumann Drive Aston PA 19014-4707

ASHRAE Calculation

Well Size	=	171 ft/ton
Cooling	=	200 tons
Heating	=	1291 Mbh
Depth of Well	=	400 ft
Wells Cooling	=	70 wells
Wells Heating	=	42 wells
Footprint	=	27,976 ft^2
Pattern	=	20 by 20 Grid

Hybrid GCHP with Cooling Tower

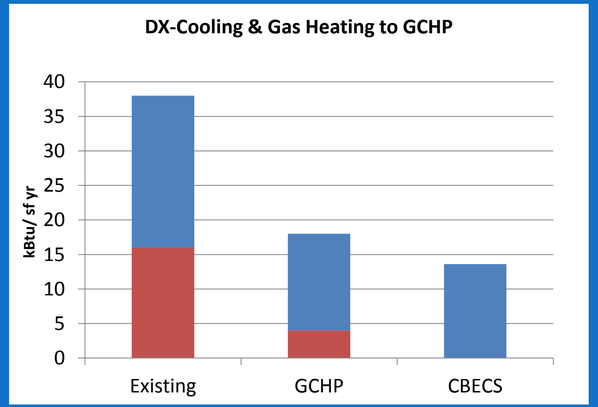
zachary heilman
architectural engineering mechanical
Presents
THE MIRENDA CENTER
For Sport, Spirituality, and Character Developement
One Neumann Drive Aston PA 19014-4707

Cost of (6) RTU	$476,269	
Well Cost (Grout + Pipe + Drilling)	$8,104	$567,305
Distribution Piping Zone (2) Pipes per Zone	$1,990	$13,933
Pumps + Elbows + Tees + Valves per zone	$650	$4,550
Cooling Tower		$50,000
Number of Wells	70	
Number of Zones	10	
Total Cost		$1,112,057
Cost of GCHP Wells		$635,788
Payback		18

ASHRAE Calculation

Well Size	=	171 ft/ton
Cooling	=	200 tons
Heating	=	1291 Mbh
Depth of Well	=	400 ft
Wells Cooling	=	70 wells
Wells Heating	=	42 wells
Footprint	=	27,976 ft^2
Pattern	=	20 by 20 Grid

Cost Analysis



zachary heilman
architectural engineering mechanical

Presents

THE MIRENDA CENTER

For Sport, Spirituality, and Character Developement

One Neumann Drive Aston PA 19014-4707

Energy Statistics

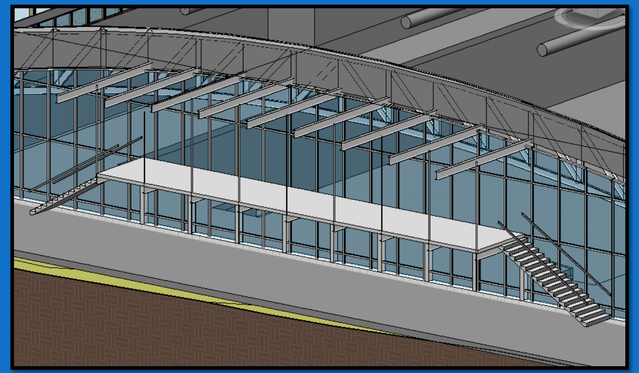
Existing Total	= 38 kBtu/ sf year
GCHP Total	= 18 kBtu/ sf year
CBECS	= 15 kBtu/ sf year
Savings	= 20 kBtu/ sf year

20 - 40 foot ceiling heights

72000 sf

Mezzanine Proposal

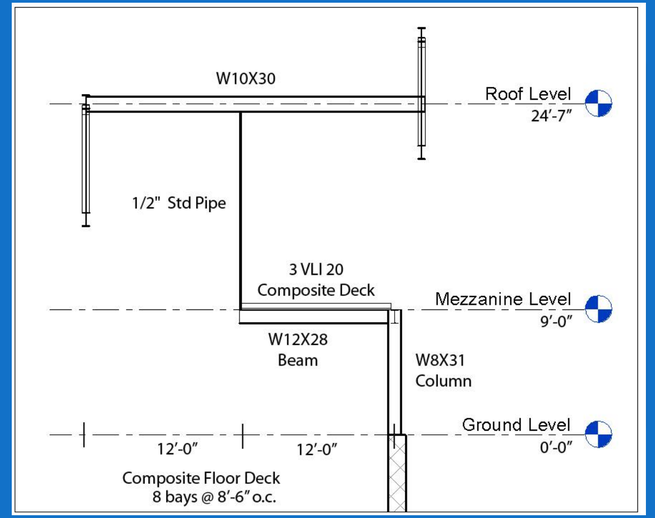
zachary heilman
architectural engineering mechanical
Presents
THE MIRENDA CENTER
For Sport, Spirituality, and Character Developement
One Neumann Drive Aston PA 19014-4707



Structural & Lighting Breadth

Load & Resistance Factor Design – Conditions		
Dead Load=	40	psf
Self-Weight=	45	psf
Live Load=	80	psf
Total Factored Load=	1.2*(Dead)+1.6*(Live)	
Mezzanine Width=	12	ft
Mezzanine Length=	70	ft
Total Thickness=	5.5	inches
Number of Bays=	8	
Total Unfactored Load (no concrete self-weight)=	120	psf
Total Unfactored Load (with concrete self-weight)=	165	psf
Total Factored Load=	230	psf

Mezzanine Proposal



zachary heilman
architectural engineering mechanical
Presents

THE MIRENDA CENTER

For Sport, Spirituality, and Character Developement

One Neumann Drive Aston PA 19014-4707

Structural Breadth

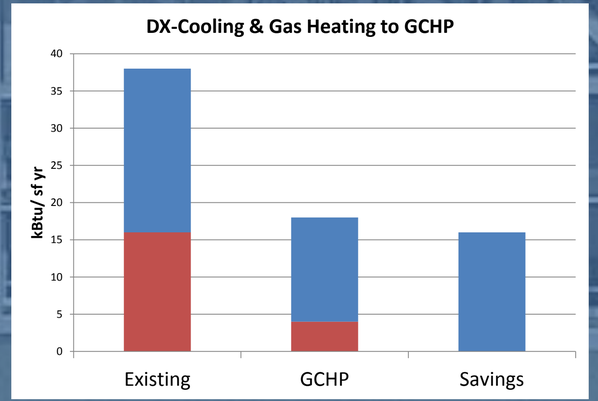
Load & Resistance Factor Design – Conditions		
Dead Load=	40	psf
Self-Weight=	45	psf
Live Load=	80	psf
Total Factored Load=	1.2*(Dead)+1.6*(Live)	
Mezzanine Width=	12	ft
Mezzanine Length=	70	ft
Total Thickness=	5.5	inches
Number of Bays=	8	
Total Unfactored Load (no concrete self-weight)=	120	psf
Total Unfactored Load (with concrete self-weight)=	165	psf
Total Factored Load=	230	psf

Overview & Recommendation

Cost of (6) RTU	$476,269	
Well Cost (Grout + Pipe + Drilling)	$8,104	$567,305
Distribution Piping Zone (2) Pipes per Zone	$1,990	$13,933
Pumps + Elbows + Tees + Valves per zone	$650	$4,550
Cooling Tower		$50,000
Number of Wells	70	
Number of Zones	10	
Total Cost		$1,112,057
Cost of GCHP Wells		$635,788
Payback		18

$ Savings = $35,321

Conventional DX Gas = $1.33/s.f.
GCHP = $0.84/s.f.



Energy Statistics

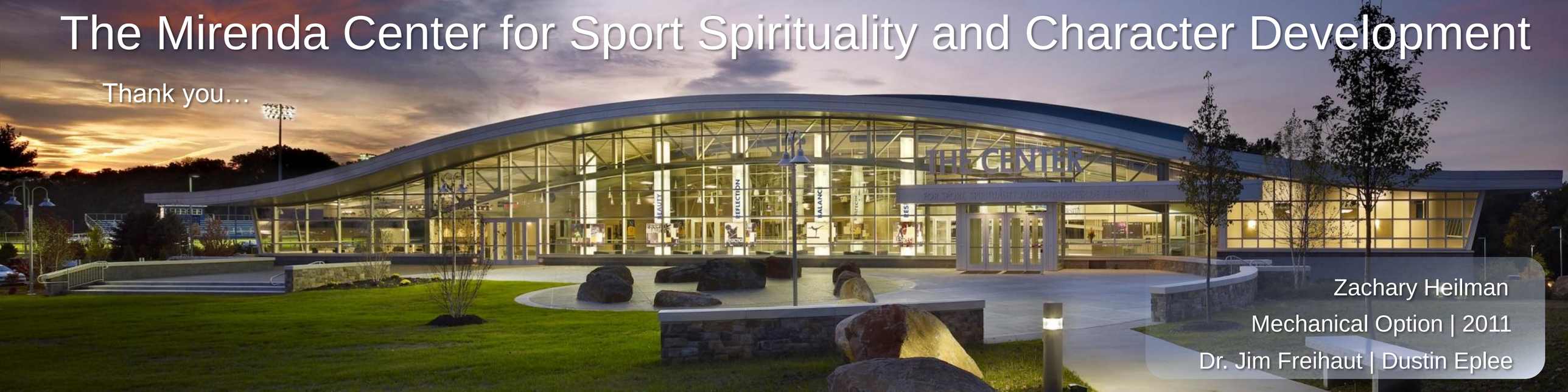
Ex. Heating = 16 kBtu/ sf year
Ex. Cooling = 22 kBtu/ sf year
Ex. Total = 38 kBtu/ sf year

GCHP Heating = 4 kBtu/ sf year
GCHP Cooling = 14 kBtu/ sf year
GCHP Total = 18 kBtu/ sf year

Savings = 20 kBtu/ sf year

The Mirenda Center for Sport Spirituality and Character Development

Thank you…



Zachary Heilman
Mechanical Option | 2011
Dr. Jim Freihaut | Dustin Eplee